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REPORT ON NORTH PLATTE RIVER SURVEY WYOMING-NEBRASKA

F. W. Kittrell

Robert A. Taft Sanitary Engineering Center
Cincinnati, Ohio

February 1962

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NORTH PLATTE RIVER SURVEY

Wyoming-Nebraska

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SEPTEMBER and NOVEMBER 1961

by

A. D. Sidio, Public Health Engineer

POLLUTION EVALUATION

F. W. Kittrell, In Charge

LC 76-611662
7/16/71

U. S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
PUBLIC HEALTH SERVICE
ROBERT A. TAFT SANITARY ENGINEERING CENTER

CINCINNATI, OHIO

FEBRUARY 1962

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REPORT ON

NORTH PLATTE RIVER SURVEY
WYOMING - NEBRASKA

SEPTEMBER and NOVEMBER 1961

BACKGROUND

During the month of December 1960 studies were made to determine the effects of wastes on bacteriological, chemical, and physical quality of the North Platte River. The area studied extended from above Torrington, Wyoming downstream to Bridgeport, Nebraska, a distance of about 67 miles.

In November of 1960 studies of the biology of the North Platte River from above Torrington to Mitchell, Nebraska were made. Additional biological studies were made during August 1961. The stretch of the river involved during the August studies extended from above Torrington to Bridgeport, Nebraska.

As a result of the studies, and at the request of the State of Nebraska a conference was held on September 12, 1961 at Scottsbluff, Nebraska. The conference recommended in part that: "The Public Health Service, in cooperation with State agencies, municipalities and industries involved, will conduct an investigation and study of the river during the current 1961-62 sugar beet campaign to obtain bacteriological, biological, chemical, stream flow, and other pertinent data to properly assess the sources of industrial and municipal wastes, the kinds of coliform bacteria present in the river, and their effects on water quality."

In September and November, 1961, the Public Health Service conducted stream studies to obtain the necessary data to properly assess the sources of industrial and municipal wastes. This report covers the chemical, bacteriological, and physical data obtained during the September and November 1961, studies.

Additional background material is available on the area in:

1. Report on Pollution of Interstate Waters of the North Platte River, Wyoming-Nebraska, September 1961. Prepared by Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio.

2. North Platte River Basin, Water Pollution Investigation, January 1951. Prepared by Public Health Service, Division of Water Pollution Control, Missouri Drainage Basin, Kansas City, Missouri.

THE AREA

The September and November 1961 studies covered the Torrington, Wyoming to Broadwater, Nebraska reach of the North Platte River. This is a distance of about 82 river miles. The reach of the river covered is shown in Chart 1.

The river is used as a source of supply for the extensive irrigation systems, and to receive the runoff of drains returning flow from the irrigated areas. The river is used as a source of industrial water supply. This use is supplemented by ground water sources, and surface sources of the river's tributaries.

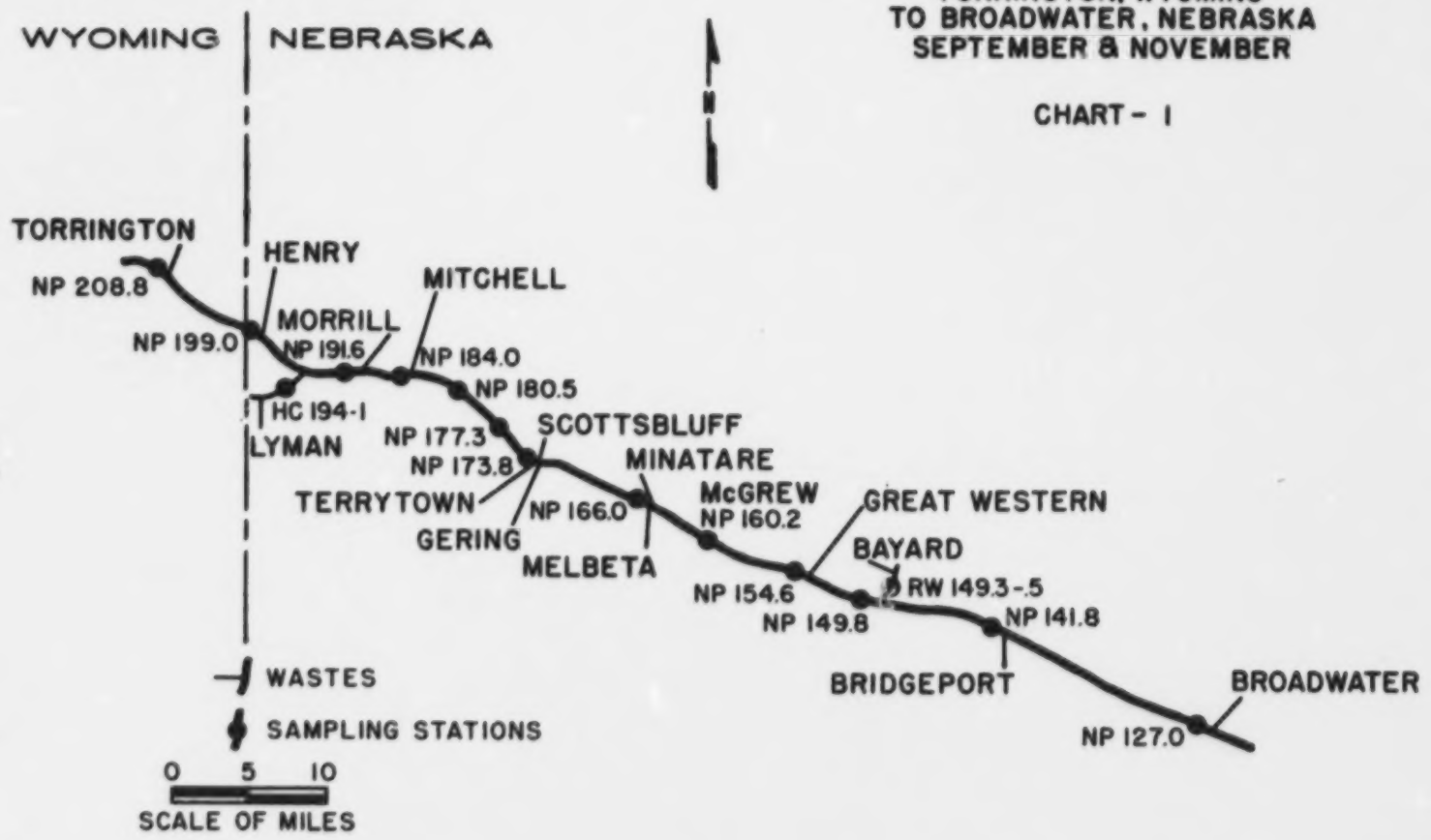
At the present time there is no known use of this reach of the North Platte as a municipal water supply, however, this is a potential use that must be considered.

Fishing and duck hunting are the primary recreational uses of the river and tributary surface waters in the area. The broad shallow depth of the river limits other recreational uses such as boating and swimming.

NORTH PLATTE RIVER SURVEY

TORRINGTON, WYOMING
TO BROADWATER, NEBRASKA
SEPTEMBER & NOVEMBER

CHART - 1



SOURCES OF WASTES

There are thirteen sewered communities in the reach of the river studied. These communities are listed in Table 1. The table also lists the contribution of bacterial pollution to the stream from each of the communities. Chart 2 presents the sources of sewage to the North Platte River from Torrington to Broadwater. The diameter of the circles indicate the relative contributions from the various sources.

At the time of the 1961 studies Torrington, Wyoming was the only community providing adequate treatment for its sewage. All other communities in the area discharge raw sewage to the river, though some have taken steps toward providing treatment for their wastes. Scottsbluff, Gering, and Terrytown have had engineering studies made. Additional progress has been made, or is being considered toward providing adequate municipal treatment facilities.

Table 2 lists the known sources of organic waste being discharged to the river. This table includes both municipal and industrial sources. Chart 3 presents the Biochemical Oxygen Demand population equivalents from each community. Again the diameter of the circle indicates the relative contribution from the various sources.

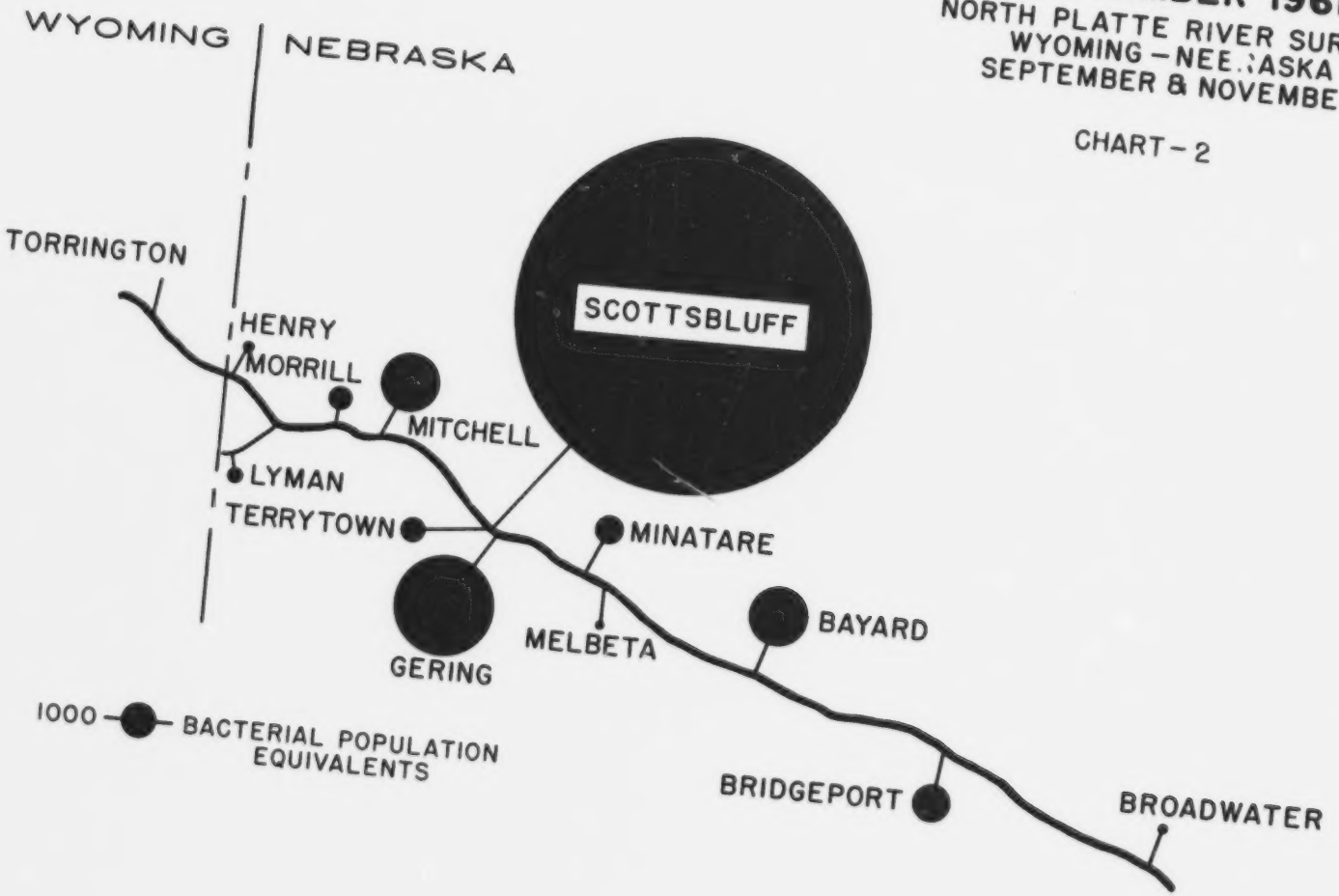
Untreated municipal wastes and other year-round waste discharges, and the seasonal waste loads of the five beet sugar plants were of major concern.

Of the five beet sugar plants one is in Wyoming and four in Nebraska. Various measures have been taken by each of these plants that has resulted in reducing the potential waste load to the river. A number

SOURCES OF SEWAGE
SEPTEMBER 1961

NORTH PLATTE RIVER SURVEY
WYOMING – NEBRASKA
SEPTEMBER & NOVEMBER

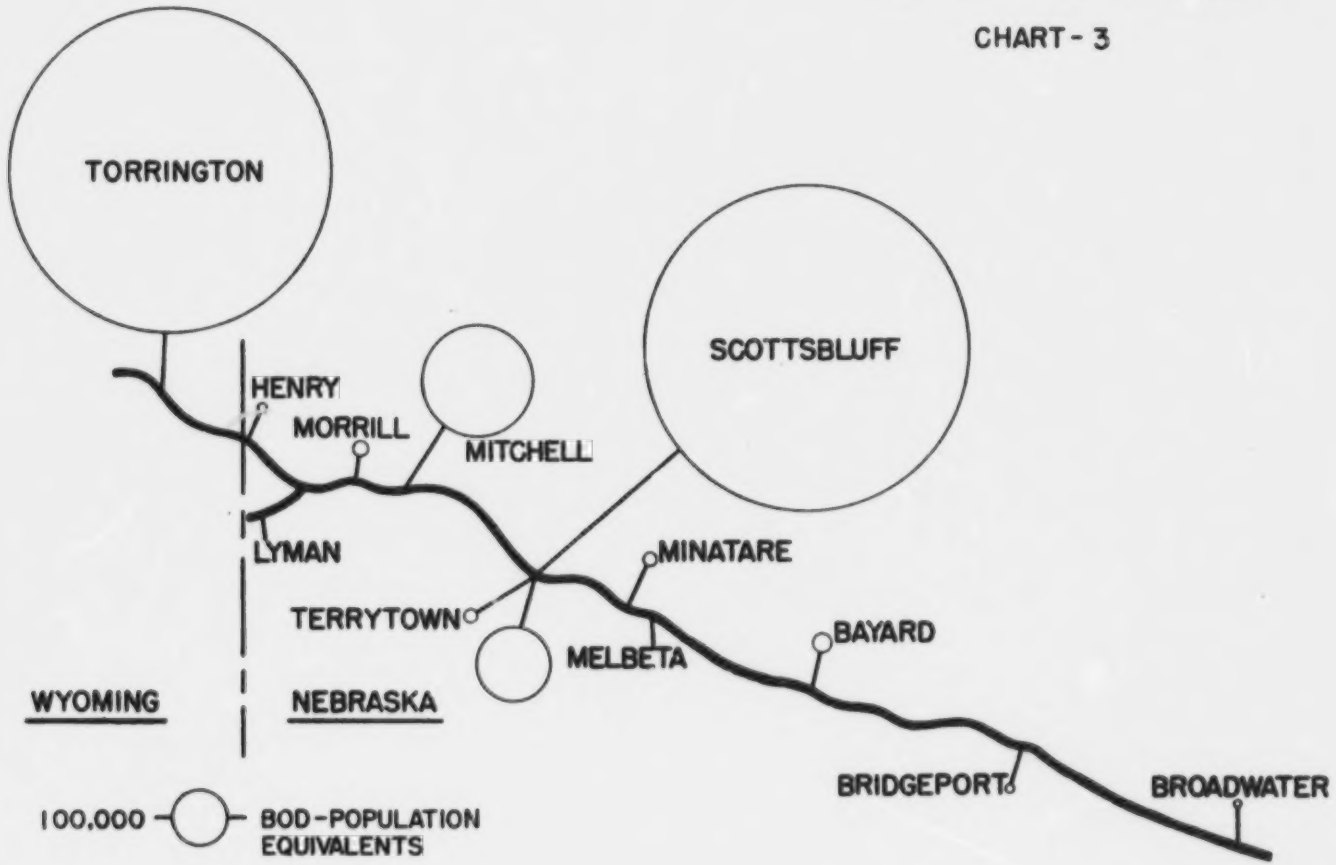
CHART – 2



SOURCES OF ORGANIC WASTES
NOVEMBER 1961

NORTH PLATTE RIVER SURVEY
WYOMING – NEBRASKA
SEPTEMBER & NOVEMBER

CHART - 3



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NORTH PLATTE RIVER SURVEY

Wyoming-Nebraska

September and November 1961

TABLE No. 1

SEWERED COMMUNITIES

	River Mile	Sewered Population	Bacterial Population Equivalent To Stream
Wyoming			
Torrington (1)	209	3,500	0
Nebraska			
Henry (1)	199	80	80
Lyman (1)	194-3.5	350	350
Morrill (1)	191	600	600
Mitchell (1)	184	1800	1800
Scottsbluff (2)	173	11000	11000
Terrytown (2)	173.8	660	660
Gering (2)	173	3500	3500
Minatare (1)	166	800	800
Melbeta (1)	166	80	80
Bayard (1)	155	1700	1700
Bridgeport (1)	142	1000	1000
Broadwater (1)	127	150	150

(1) Data from U.S.P.H.S. 1957 Inventory of Municipal and Industrial Waste Facilities.

(2) Computed from 1957 U.S.P.H.S. Inventory of Municipal and Industrial Waste Facilities, 1960 Census figures, and engineering reports prepared for the cities based on estimated populations for 1958.

NORTH PLATTE RIVER SURVEY

Wyoming-Nebraska

September and November 1961

TABLE No. 2

SOURCES OF ORGANIC WASTES

Source	River Mile	BOD Population Equivalent Individual Source	Total For Area
Wyoming			
Torrington	209	0	606,000
Holly Sugar Co.(1)		606,000	
Nebraska			
Henry(2)	199	80	580
Platte Valley Poultry(2)		500	
Lyman(2)	194-1	350	350
Morrill(2)	191	840	840
Mitchell(2)	184	2,600	206,600
Gr. Western Sugar Co.(1)		204,000	
Scottsbluff(3)	173	12,250	599,680
Co-op. Oil Refinery(2)		1,200	
Flicker Packing(2)		550	
Gr. Western Sugar Co.(1)		580,000	
H & B Packing Co.(2)		720	
Hersch Packing Co.(2)		1,160	
Idlewild Dairy(2)		1,600	
Scottsbluff Rendering(2)		2,200	
Terrytown(3)	173.8	660	660
Gering(3)	173	3,500	133,600
Gr. Western Sugar Co.(1)		97,000	
Miller Packing Co.(2)		100	
Swift & Co. Packing(2)		33,000	
Melbeta(2)	166	80	80
Minatare(2)	166	800	800
Bayard(2)	150	1,700	17,200
Gr. Western Sugar Co.(1)		15,500	
Bridgeport(2)	142	2,390	2,390
Broadwater(2)	127	150	150
		TOTAL FOR REACH	1,568,930

(1) Computed from data collected during November 1961 Study - See Table 5.
(2) Data from U.S.P.H.S. 1957 Inventory of Municipal and Industrial Waste Facilities.
(3) Computed from U.S.P.H.S. 1957 Inventory of Municipal and Industrial Waste Facilities, 1960 Census Figures, and Engineering Reports prepared for the cities based on estimated populations for 1958.

of these measures have been taken for the direct purpose of reducing pollution. Other waste load reductions have resulted from process changes.

Changes that have been made at each of the beet sugar plants that have reduced the potential waste load to the river, along with the wastes discharged during the November 1961 study are discussed in Appendix D.

SURVEY METHODS

Two studies of the effects of pollution on chemical, bacteriological, and physical quality were made of the Torrington, Wyoming to Broadwater, Nebraska reach of the North Platte River. The first study was conducted during September 21 through 28, 1961 just prior to the 1961-62 beet sugar processing campaign. The second was during November 7 through 20, 1961, approximately one month after the campaign had started.

Sampling stations were selected at points considered to be most desirable for determining the quality of the river above and below discharges of the various wastes. Table 3 lists the sampling stations by number, river miles and description.

During the September study samples were collected once daily at each of the 15 stream stations and the waste discharge line of the Gering sugar plant. Sampling times at individual stations were varied between 7:00 A.M. and 3:30 P.M., by changing starting times, and the order of sampling.

NORTH PLATTE RIVER SURVEY

Wyoming-Nebraska

September and November 1961

TABLE No. 3

STATION No. 1 (NP-208.8) --- Torrington Bridge.

INSERT #1 U. S. Hwy. 85, Southern edge of Torrington, Wyoming, above the sources of wastes considered in this study.

STATION No. 2 (NP-199.0) --- Henry Bridge.

State Hwy. 92 Correction about 1 mile south of Henry, Nebraska. Sec. 4-R58W-T23-N. Approximately 10 miles below Torrington, and Holly sugar plant outfall.

STATION No. 3 (HC-194-1) --- Bridge crossing Horse Creek.

Approximately 1 mile upstream of confluence with North Platte. Approximately 3 miles Northeast of Lyman, Nebraska. Sec. 25-R58W-T-23-N.

STATION No. 4 (NP-191.6) --- Bridge south of Morrill.

State Spur 226 about 2 miles south of Hwy. 26. Line Secs. 27-28-R-57W-T-23N. Approximately 17 miles below Torrington, and Holly sugar plant outfall. Above Morrill discharge.

STATION No. 5 (NP-184) --- Bridge south of Mitchell.

On paved Hwy. about 1 mile south of Mitchell, Nebraska. Line Secs. 33-34-R56W-T-23N. Approximately 25 miles below Torrington - below Morrill discharge - above Mitchell discharge and Great Western Mitchell plant discharge.

STATION No. 6 (NP-180.5) --- Point about midway between Mitchell and Riverside, Nebraska.

Wade sample on John B. Cook property - about midpoint of Sec. 1 -R56W-T-22N. Below Mitchell and Great Western Mitchell plant discharge.

TABLE No. 3
(Continued)

STATION No. 7 (NP-177.3) --- Bridge west of Scottsbluff on 20th. St.

Sec. 20 R55W-T-22N. Below Mitchell and Great Western Mitchell plant discharge.

STATION No. 8 (NP-173.8) --- Bridge between Scottsbluff, Terrytown and Gering.

Sec. 26 R55W-T22N. Above Scottsbluff, Terrytown and Gering discharges; also above Great Western's Scottsbluff and Gering plant discharges.

STATION No. 9 (NP-166.0) --- Minatare - Melbeta Bridge.

On line of Sec. 13 R54W-T21N - and Sec. 18 R53W-T21N. Below Scottsbluff, Terrytown and Gering area discharges, including the two sugar plant discharges.

STATION No. 10 (NP-160.2) --- Bridge north of McGrew.

Secs. 25 and 36 - R53W-T21N. Below Scottsbluff, Terrytown and Gering area discharges.

STATION No. 11 (NP-154.6) --- Bridge on U. S. Hwy. 26 about 1-1/2 miles south of Bayard, Nebraska.

Secs. 9-4, R52W-T20N. Above Bayard and Great Western Bayard plant discharges.

STATION No. 12 (NP-149.8) --- Belmont Diversion Dam.

Sec. 18 - R51W-T20N. Below Great Western Bayard plant discharge; above Bayard municipal waste discharge to the North Platte.

STATION No. 13 (RW-149.3-0.5) Red Willow Drain.

Sec. 17-R51W-T20N. Approximately 6 miles southeast of Bayard, Nebraska. Carries Bayard municipal wastes.

STATION No. 14 (NP-141.8) --- Bridge U. S. Hwy. 26 about 1/4 mile north of Bridgeport, Nebraska.

Sec. 28-R50W-T20N. Below Bayard municipal wastes, and Great Western Bayard plant discharge; above Bridgeport municipal discharge.

TABLE No. 3
(Continued)

STATION No. 15 (NP-127) --- Bridge Hwy. 26 south of Broadwater, Nebraska.

Sec. 33-R48W-T19N. Below Bridgeport discharge and above Broadwater discharge.

STATION No. 16 (GG-173-1.5) --- Great Western Sugar Company, Gering plant waste ditch.

STATION No. 19 (HT-208.8) --- Holly Sugar Company, Torrington plant outfall.

STATION No. 20 (GM-184-1.5) --- Great Western Sugar Company, Mitchell plant waste ditch.

STATION No. 21 (GS-173.8-3.0) - Great Western Sugar Company, Scottsbluff Plant waste ditch.

STATION No. 22 (GB-150-2.5) -- Great Western Sugar Company, Bayard Plant discharge to broadfield irrigation system.

STATION No. 23 (GB-150-2.0) -- Great Western Sugar Company, Bayard Plant effluent from broadfield irrigation system.

STATION No. 24 (MG-173-1.5) -- Gering municipal waste line. Designated "Outlet No. 1" in engineering report prepared for City in February 1959.

During November samples were collected daily for 14 consecutive days from the fifteen stream stations. In addition daily samples were collected for bacteriological analysis and temperature readings from each of the six stations on the beet sugar plant waste ditches. Sampling times were varied during the first twelve (12) days from 6:30 A.M. to 4:30 P.M. On the last two days of the survey (November 19 and 20) samples were collected between 1:30 and 7:30 A.M. Eight-hour composite samples for chemical analysis were collected from each of the plant waste ditches for four consecutive days.

LABORATORY FACILITIES

All analyses, with the exception of those on samples returned to Cincinnati for chloride, calcium, sulfate and sodium analyses, were made in a mobile laboratory.

The laboratory was located on the grounds of the Scottsbluff municipal building in Scottsbluff, Nebraska.

Additional laboratory facilities were made available by the Western Branch of the Nebraska State Health Department located in Scottsbluff. These facilities were used primarily for sterilization and preparation of media.

Approximately 600 samples were received in the mobile laboratory during the 21 days of sampling. Approximately 5,700 chemical, physical, and bacteriological analysis were run on the samples.

Analyses

All analyses, with the exception of two, were performed in accordance with "Standard Methods for the Examination of Water and Wastewater" eleventh edition, 1960. The two exceptions were the examinations for fecal coliform, and fecal streptococci. Descriptions of the methods used in determining the fecal coliform, and fecal streptococci densities are included in the Appendix C.

Chemical and physical analyses included; temperature, dissolved oxygen (D.O.), 5-day 20° C. biochemical oxygen demand (B.O.D.), suspended solids, volatile suspended solids, hydrogen ion concentration (pH), alkalinity, chloride, hardness, calcium, magnesium, conductivity, color, turbidity, sodium, and sulfate.

Bacteriological determinations included; most probable number (MPN) for total coliform group, MPN for fecal coliform, and fecal streptococci by the membrane filter method.

Physical observations of the river were made routinely during the studies by sampling personnel, and at opportune times by supervisory personnel.

HYDROLOGICAL DATA

Stream flow data during the two study periods were provided by the State of Nebraska, Department of Water Resources, Bridgeport, Nebraska and the U. S. Geological Survey, Casper, Wyoming.

Time of travel was based on a velocity of 2.2 feet per second, or 1.5 miles per hour.

Flow measurements were made on each of the five beet sugar plant wastes during the November study. During the September study waste flow measurements were made on the Gering plant discharge line only. Wastes, originating from stockyards, were being discharged to the Gering plant waste line prior to its point of discharge to the waste ditch.

Flow measurements of the sugar plant waste ditches during the November study were made by means of a Parshall flume, with the exception of the Holly Sugar Company Torrington plant. Measurements were made of the Torrington plant wastes by means of two 2.5 feet opening rectangular weirs located in the new screen house. A flow level recording device was installed and placed in operation by personnel of the Wyoming State Engineers' Office.

The Parshall flume used during the study was designed by the Engineering Department, and constructed by the maintenance shop of the Great Western Sugar Company in Scottsbluff. The unit was of standard design with a throat width of 24 inches.

At the Bayard plant the waste is pumped from the plant waste ditch to a distribution flume across the upper end of the broad-field irrigation system. An existing Parshall flume in the distribution system was used for flow measurements.

The bypass line provided in the waste ditch, near the pump house, in the Bayard Plant broad-field disposal system was observed flowing on numerous occasions during the November study. The method of transporting the wastes from the plant, and the function of the bypass line are discussed in Appendix D.

Calculations, based on flow measurements of the other plants, indicate that an average of between one-half and one cubic foot per second discharged from this line to an adjacent canal.

The Parshall flume, used at the other three Great Western plants, was used in the collection ditch of the broad-field irrigation system of the Bayard plant. During the early part of the November survey a considerable amount of reconditioning was done on the broad-field system, consisting of sandbagging and diking of channels that had developed across the field. The reconditioning caused an interruption of the normal flow across the field, by flooding additional areas. Flow measurements made on the collection ditch of the Bayard field are not indicative of the normal discharge from the field. The results on the Bayard plant are not considered indicative of reduction efficiencies of the field.

EFFECTS OF WASTES ON WATER QUALITY

The results of individual sample analysis for the September and November studies are presented in Appendix A. Averages of chemical and physical data for the thirteen river stations, the two tributary stations and the September data for Station (16) (GG-173-1.5) (Gering plant waste discharge line) are presented in Table 4. Chemical and physical data on each of the five beet plant wastes are recorded in Table 5.

FLOW DATA

Average flow data for each of the stream stations during the two studies are presented in Table 4.

The extensive utilization of the North Platte River for irrigation purposes is indicated by the flow recorded at the state line (near Henry, Nebraska) Station (528 cfs) during the September period, and the flow recorded during the same period at the Mitchell Station (212 cfs) some twenty miles downstream. During the November study the flow increased progressively downstream in the reach considered.

TEMPERATURE

Temperature measurements were made and recorded in Centigrade degrees in the field immediately following removal of the sample from

WHITE PLAINS RIVER SURVEY
WOODED-HERMANS
SEPTEMBER-AND-NOVEMBER 1962

SUMMARY OF RIVER STATIONS-CHEMICAL DATA TABLE No. 4

ITEM	MONTH	1 RM26.8	2 RM19.0	3 (2) RM18.1	4 RM16.6	5 RM15.0	6 RM10.5	7 RM7.1	8 RM3.8	9 RM1.0	10 RM0.8	11 RM0.6	12 RM0.2	13(3) RM14.3-.5	14 RM11.8	15 RM7.0	16(3) 03173-1.5
FLOW Cubic Feet per Second	SEPT.	588	588	56	171	212	284	304	307	448	565	665	723	145	843	1,070	0.55
	NOV.	317	317	27	496	497	541	582	627	786	857	884	951	79	1,088	1,897	-
TEMPERATURE °C.	SEPT.	12	11	11	12	12	12	12	10	13	13	13	12	13	12	13	15
	NOV.	4	4	2	4	4	5	5	5	5	5	5	5	6	4	3	-
pH	SEPT.	8.1	8.1	8.4	8.2	8.2	8.1	8.1	8.2	8.1	8.1	8.1	8.2	-	8.1	8.2	8.0
	NOV.	8.2	7.9	8.4	8.0	8.0	8.0	8.0	8.0	7.9	7.9	7.9	7.9	8.1	8.0	8.1	-
DISSOLVED OXYGEN	SEPT. mg/l	9.0	9.4	9.8	9.0	9.5	9.1	9.3	9.4	8.1	8.0	8.6	8.8	8.8	9.0	9.2	6.2
(Elev.-A000')	Sat.	97.0	100.0	104.0	97.0	103	99	101	97	89	89	95	93	96	98	102	71
	NOV. mg/l	10.6	9.1	11.7	8.6	8.7	7.5	7.4	7.2	6.5	6.3	5.7	7.1	10.3	8.6	10.5	-
	Sat.	95	78	99	76	78	68	67	65	61	59	53	64	98	76	98	-
BIOCHEMICAL OXYGEN	SEPT. mg/l	1.5	1.6	2.4	2.1	2.0	2.0	2.2	2.8	4.9	4.7	4.6	4.4	-	3.4	3.6	10.4
DEMAND	thousands of lbs/day	4.2	4.5	.736	1.9	2.33	3.08	3.88	4.25	12.1	10.95	14.4	17.3	-	13.34	20.4	.031
5 day-20°C.	NOV. mg/l	1.0	48.4	1.9	26.5	20.0	25.6	19.7	15.4	33.9	37.6	21.8	18.4	1.5	17.1	11.1	-
	thousands of lbs/day	1.71	58.2	.276	58.2	53.5	74.6	61.5	51.5	138.7	180.0	104.2	99.6	.595	97.6	76.0	-
DISSOLVED SOLIDS	SEPT. mg/l	17.6	22.6	67.4	58.0	83.4	49.0	52.6	53.1	178	455	373	290	-	387	868	84
	thousands of lbs/day	30.2	64.2	20.3	84.8	99.4	75.0	51.8	166.5	986	1,457	1,337	1,447	-	1,760	1,480	.057
	NOV. mg/l	8.9	67.0	91.9	83.4	106	147	158	139	406	411	398	387	37.9	406	324	-
	thousands of lbs/day	15.8	114.6	13.4	261.6	268.4	427.	497.0	435.0	1,586	1,838	1,898	1,889	14.7	2,389	2,077	-
VOLATILE SUSPENDED SOLIDS	SEPT. mg/l	7.3	9.7	17	14	7.4	10	9	12	29	35	37	30	-	32	25	15
	thousands of lbs/day	20.75	22.5	5.1	12.9	8.5	15.3	15.7	23.7	72.2	110.4	138.6	118.5	-	146.8	141.5	.045
	NOV. mg/l	5.1	39.3	20.6	22.3	26	36	37	32	64	68	69	64	11	69	49	-
	thousands of lbs/day	8.7	52.1	3.0	46.8	70.8	105.4	115	106.7	249.7	292.8	309.6	289.0	4.85	327.8	333.7	-
TOTAL ALKALINITY as $CaCO_3$	SEPT. mg/l	192	204	416	313	241	270	268	269	278	281	270	276	-	268	261	278
	thousands of lbs/day	346	581	135	388	275	413	468	532	698	886	968	1,090	-	1,139	1,477	1.18
	NOV. mg/l	181	205	167	213	214	224	225	228	249	253	251	250	197	246	238	-
	thousands of lbs/day	309	350	51.6	467	374	649	705	770	973	1,150	1,188	1,282	76.6	1,406	1,686	-
TURBIDITY-SECCHI	SEPT.	< 25	<26	27	118	37	36	<44	68	105	115	122	129	-	126	154	<23
	NOV.	< 25	47	69	44	40	69	71	66	123	129	128	126	<25	115	101	-
TRUE COLOR-UNITS	SEPT.	7	8	87	16	11	10	12	12	12	12	12	15	-	12	13	23
	NOV.	6.6	14	28	12	12	13	12	12	15	13	13	13	7.4	12	11	-
HARDNESS as $CaCO_3$	SEPT. mg/l	302	301	176	253	287	284	294	295	297	300	305	308	-	309	298	386
	thousands of lbs/day	560	857	53.2	434	340	435	515	585	742	949	1,099	1,280	-	1,450	1,690	.970
	NOV. mg/l	300	299	177	280	269	302	304	308	318	323	322	325	316	322	313	-
	thousands of lbs/day	515	510	25.8	631	775	805	933	1,040	1,270	1,380	1,330	1,460	173	1,570	2,140	-
CALCIUM as $CaCO_3$	SEPT. mg/l	204	186	118	160	178	181	195	186	175	197	193	187	-	196	187	219
(1)	NOV. mg/l	173	198	188	116	176	210	178	210	240	200	209	211	204	208	194	-
MAGNESIUM as $CaCO_3$	SEPT. mg/l	98	115	58	93	113	93	99	107	122	93	112	121	-	143	131	167
	NOV. mg/l	127	107	99	172	113	98	126	108	78	103	109	103	112	96	159	-
SPEC.CONDUCTANCE MICROMHOS/CM	SEPT.	697	733	1,835	919	846	813	819	818	887	841	881	891	-	819	795	990
	NOV.	730	779	1,330	893	797	797	795	806	845	893	930	898	754	833	786	-
CHLORIDE (Cl^-)	SEPT. mg/l	16.8	17.9	31.7	22.4	20.3	19.5	18	20.1	22.6	23.8	23.0	25.9	-	22.8	22	41
(4)	NOV. mg/l	6.0	5.0	17.5	6.0	6.0	5.5	5.0	4.5	5.5	4.0	5.5	4.5	5.0	5.5	5.5	-
SODIUM (Na^+)	SEPT. mg/l	90	95	260	175	185	185	185	185	190	140	130	125	-	130	120	150
(4)	NOV. mg/l	68	89	270	95	98	97	89	98	88	95	93	94	69	92	85	-
SULFATE ($SO_4^{=}$)	SEPT. mg/l	205	210	270	246	213	197	218	214	232	256	240	268	-	243	233	187
	NOV. mg/l	180	195	259	199	186	189	196	208	195	200	197	208	184	189	161	-

(1) Calculated.
(2) Tributary Stations.
(3) Station (16) 03173-1.5 is Great Western Curing Plant. For November results - See Table No. 5
(4) Samples Composited and Returned to Cincinnati for Analysis.

NORTH PLATTE RIVER SURVEY
WYOMING-NEBRASKA
SEPTEMBER-AND-NOVEMBER 1961

SUMMARY OF DATA-SUGAR PLANT WASTES TABLE No. 5

DATA / STATIONS	(16)GR173-1.5 (5) GR.WESTERN GERING (Total)	(5) (Corretd)	(19)NP208.8 HOLLY-TORRINGTON	(20)GR154-1.5 GR.WESTERN-MITCHELL	(21)GR173.8-3.0 GR.WESTERN-SCOTTSBLUFF	(22)GR150-2.5 (2) GR.W. BAYARD PLANT (Discharge From)	(23)GR150-2.0 (2) GR.W. BAYARD (Effluent Fr. Field)
Flow in CFS	10.96	10.41	14.11	9.85	13.14	8.00	2.40
Tons of Beets Processed	Nov.8-9-10-11/'61		Nov.12-13-14-15/'61	Nov.12-13-14-15/'61	Nov. 8-9-10-11/'61	Nov.16-17-18-19/'61	Nov.16-17-18-19/'61
4-day Plant Sampling Avg/day	2,557		3,162	2,399	3,627	2,116	2,116
Nov7-20 Samplg.Per.Avg/day	(2,507)		(3,121)	(2,438)	(3,602)	(2,103)	(2,103)
Temp. °C.	35		38	27	35	30	3
pH	7.6		8.8	9.2	10.5	8.9	7.7
BOD mg/l (5-day 20°C.)	278		1,360	666	1,395	583	204
LBS. PER DAY	16,450	16,419	103,000	35,370	98,970	25,200	2,640
PE @ 0.17 LBS./CAP./DAY (3)	97,000	96,600	606,000	204,000	580,000	148,000	15,500
LBS.BOD/TON of Beets Proc'd.	6.38		32.57	14.74	24.53	11.91	1.25
SUSPENDED SOLIDS mg/l	3,108		1,417	5,158	5,882	6,163	143
LBS. PER DAY	183,600	183,530	107,500	273,800	416,600	265,000	1,862
PE @ 0.20 LBS./CAP./DAY (3)	918,000	917,615	537,500	1,369,000	2,083,000	1,325,000	9,310
LBS./TON of Beets Proc'd.	71.78		34.00	114.08	114.86	124.24	0.88
VOLATILE SUSP. SOL. mg/l	331		326	876	948	898	49
% of SUSP. SOLIDS	10.6		23	17	16.4	14.6	34
LBS. PER DAY	19,550	19,500	24,700	46,500	67,100	38,600	640
ALKALINITY PHENOL. mg/l as $CaCO_3$	0		82	35	155	21	0
TOTAL mg/l	224		322	191	417	209	356
HARDNESS mg/l as $CaCO_3$	309		508	322	635	341	464
CALCIUM mg/l (4) as $CaCO_3$	304		-	120	255	200	265
MAGNESIUM mg/l (1) as $CaCO_3$	5		-	202	380	141	199
COLOR(TRUE) UNITS	49		187	64	192	52	55
TURBIDITY-UNITS	975		1025	1750	1900	1875	123
SPEC.CONDUCTANCE MICROMHOS/cm.	794		924	658	1435	779	999
CHLORINE (Cl^-) mg/l (4)	5.0		43.5	10.0	6.5	31.5	8.0
SODIUM (Na^+) mg/l (4)	67		79	49	72	75	84
SULFATE ($SO_4^=$) mg/l (4)	147		3	12	57	28	134

(1) Calculated.
(2) Neither flow includes direct discharge of overflow pipe. Data does not include total flows.
(3) Calculations based on tons Processed - 4-day Sampling Period.
(4) Samples Composited for 4-day Sampling Period and Returned to Cincinnati for Analysis.
(5) Corrected Values - allow for flow in Gering Plant line during September.

the source. A comparison of average temperatures between September and November at each of the river stations is presented in Table 4.

Temperatures of the sugar plant wastes averaged from 27° C. to 38° C. Temperatures of the wastes did not measurably affect the temperatures of the river.

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pH(HYDROGEN ION CONCENTRATION)

Average pH values for September and November are presented in Table 4 for stream stations, and in Table 5 for plant sampling stations.

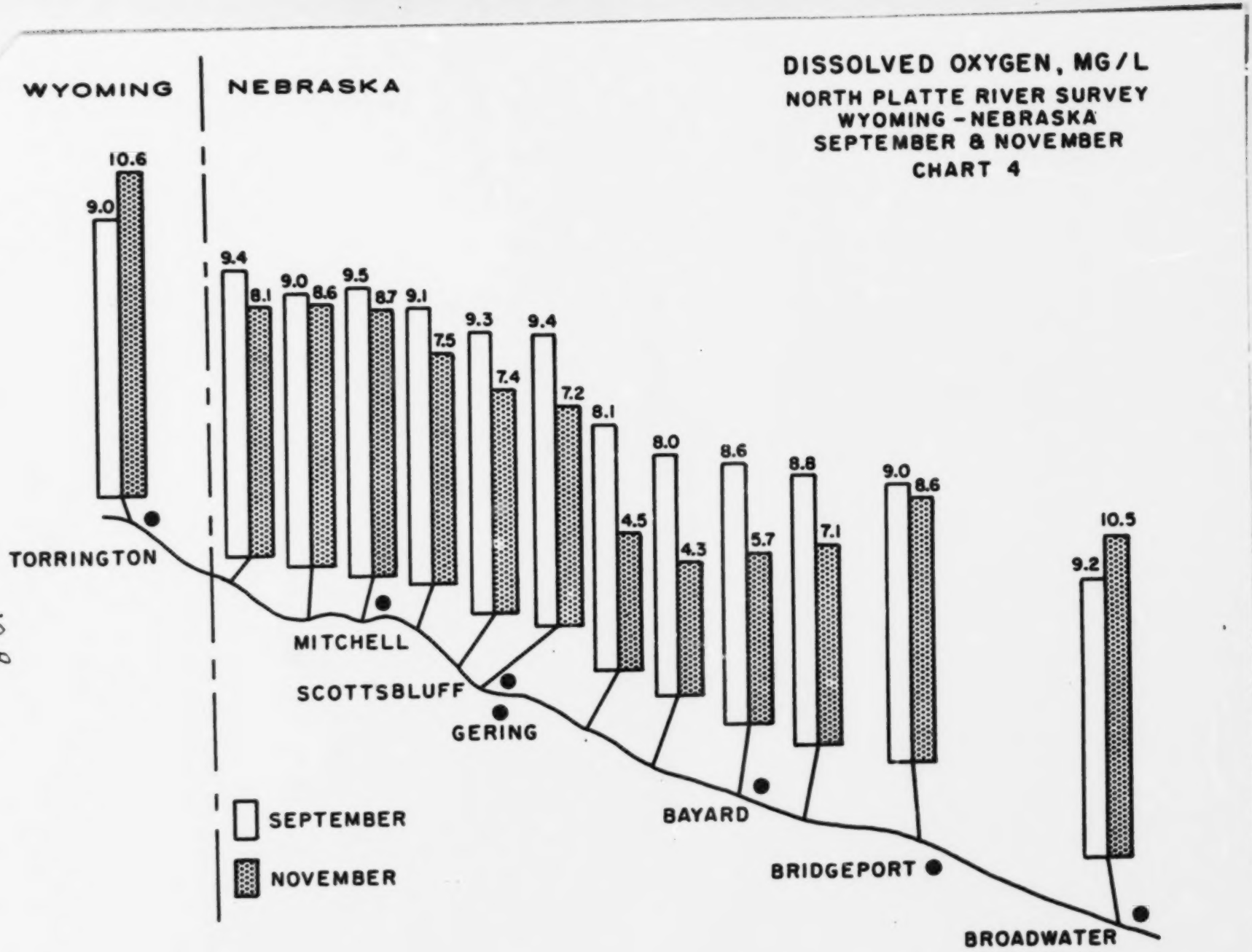
DISSOLVED OXYGEN

Average dissolved oxygen concentrations and percentage of saturation values are presented in Table 4. During the September study concentrations approached, and in some cases exceeded, saturation values to a point below the Scottsbluff-Gering-Terrytown Area. At the Minatare Station (NP-166.0), the concentration dropped to 8.1 mg/l. At the next station, McGrew Bridge (NP-160.2) the concentration was 8.0 mg/l. Below McGrew, the river recovered and at the Broadwater Station (NP-127.0) had a concentration of 9.2 mg/l or 101 per cent saturation.

Dissolved oxygen saturation levels are inversely proportional to temperatures. With the lower temperatures recorded during November higher concentrations of oxygen were required to reach saturation levels.

Chart 4 presents a comparison of dissolved oxygen concentration in mg/l at each of the river stations for September and November.

Chart 5 presents a comparison of per cent saturation values of the two study periods.

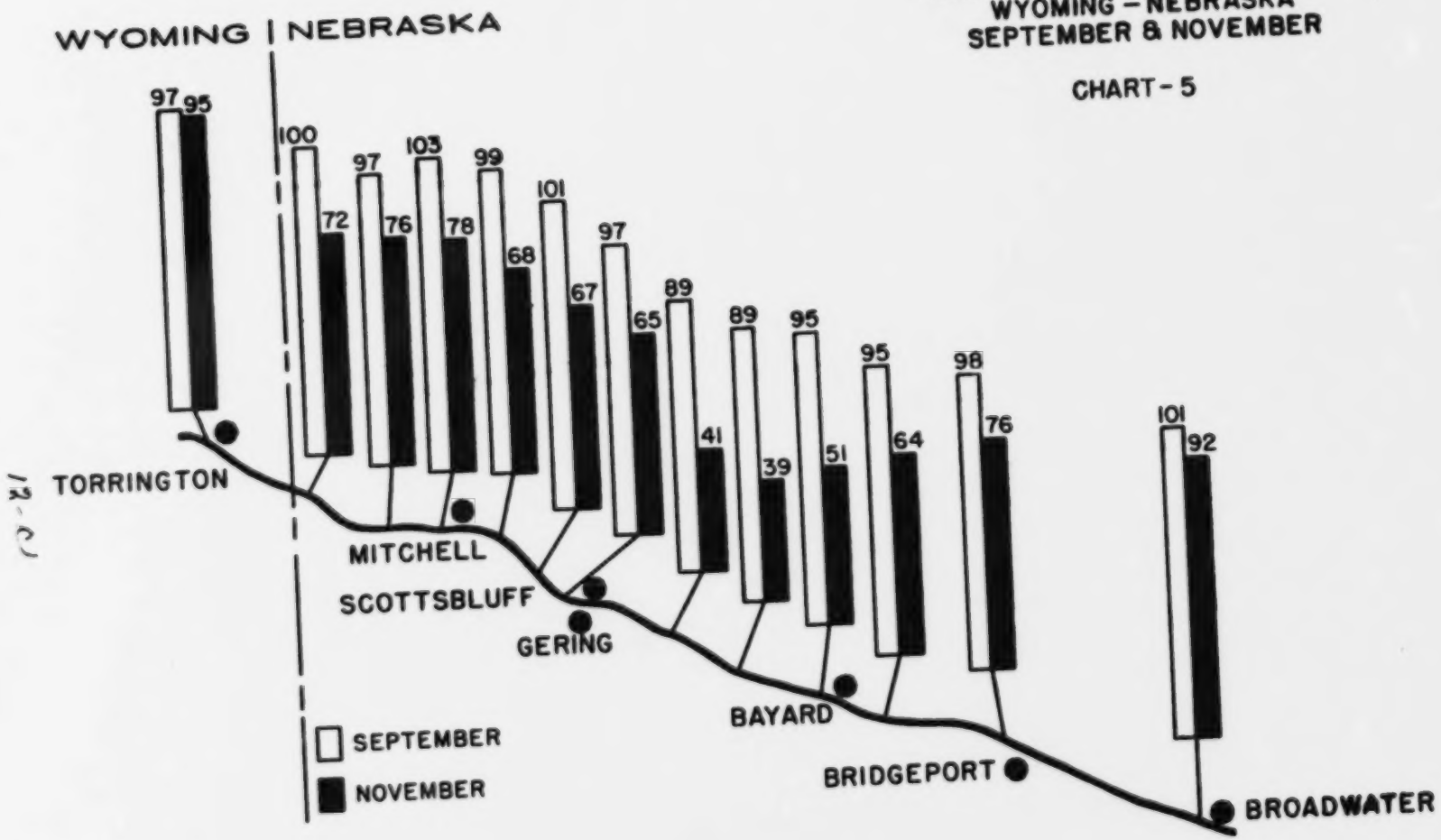

DISSOLVED OXYGEN, MG/L
NORTH PLATTE RIVER SURVEY
WYOMING - NEBRASKA
SEPTEMBER & NOVEMBER
CHART 4
WYOMING
NEBRASKA
10.6
9.0
9.4
8.1
9.0
8.6
9.5
8.7
9.1
7.5
9.3
7.4
9.4
7.2
8.1
4.5
8.0
4.3
8.6
5.7
8.8
7.1
9.0
8.6
10.5
9.2
TORRINGTON
MITCHELL
SCOTTSBLUFF
GERING
BAYARD
BRIDGEPORT
BROADWATER
SEPTEMBER
NOVEMBER

12-B

DISSOLVED OXYGEN
PERCENTAGE OF SATURATION

NORTH PLATTE RIVER SURVEY
WYOMING – NEBRASKA
SEPTEMBER & NOVEMBER

CHART - 5



13-21

Table 6 presents dissolved oxygen balance data at and between each of the stream stations during the November study.

During November the D.O. at Torrington averaged 10.6 mg/l, or 95 per cent saturation for the average temperature of 4° C. At Henry (NP-199.0) below the Torrington plant wastes, the concentration dropped to 8.1 mg/l or 72 per cent saturation. At the next station, Morrill Bridge (NP-191.6), the D.O. started to recover. The concentration increased to 8.6 mg/l or 76 per cent saturation.

The average D.O. concentration at Mitchell was 8.7 mg/l or 78 per cent saturation. Between the Torrington and Mitchell Stations approximately 51,000 pounds of B.O.D. per day were removed. The additional flow of 180 cfs at D.O. saturation levels would provide 10,900 pounds per day. The total oxygen required is the 51,000 pounds to reduce the B.O.D. plus the 5,200 pounds of additional oxygen available at Mitchell as compared to the Torrington Station. The amount absorbed was 45,300 pounds in the 25-mile section. This indicates the high reaeration rate encountered in the entire reach of the river studied.

At the first station below Mitchell (NP-180.5) the dissolved oxygen dropped to 7.5 mg/l or 68 per cent saturation. From this station the drop in dissolved oxygen continued to a point well below the Scottsbluff-Gering Area.

At the Minatare Station (NP-166.0) the D.O. dropped to an average of 4.5 mg/l or 41 per cent saturation. At McGrew (NP-160.2) the average D.O. dropped to 4.3 mg/l or 39 per cent saturation.

NORTH PLATTE RIVER SURVEY

Wyoming-Nebraska

September and November 1961

TABLE No. 6

SUMMARY OF DISSOLVED OXYGEN DATA

STATION	FLOW (cfs)	D.O. mg/l	D.O. Lbs/day	D.O. Lbs/day Consumed by B.O.D. (Apparent)	(1) D.O. Lbs/day From Additional Flow	(2) D.O. Absorbed in reach Lbs/day
(1) (NP-208.8)	317	10.6	18,200			
to				22,500	0	18,200
(2) (NP-199.0)	317	8.1	13,900			
to				24,000	5,400	23,400
(4) (NP-191.6)	406	8.6	18,900			
to				4,700	5,500	3,700
(5) (NP-184.0)	497	8.7	23,400			
to				14,400	2,700	10,200
(6) (NP-180.5)	541	7.5	21,900			
to				13,100	2,500	11,900
(7) (NP-177.3)	582	7.4	23,200			
to				10,000	2,700	8,300
(8) (NP-173.8)	627	7.2	24,200			
to				42,800	6,000	30,100
(9) (NP-166.0)	726	4.5	17,500			
to				12,700	4,900	9,000
(10) (NP-160.2)	807	4.3	18,700			
to				15,800	4,650	19,650
(11) (NP-154.6)	884	5.7	27,200			
to				14,400	4,050	19,550
(12) (NP-149.8)	951	7.1	36,400			
to				2,000	6,700	8,400
(14) (NP-141.8)	1062	8.6	49,500			
to				21,600	12,400	31,500
(15) (NP-127.0)	1267	10.5	71,800			
				198,000	57,500	193,900

(1) All tributary Flow Calculated at Saturation level of 11.2 mg/l of Dissolved Oxygen at 4° C.

(2) Balance

D.O. absorbed = D.O. End - D.O. beginning + D.O. consumed - D.O. in added flow.

From McGrew to the Bayard Bridge Station, the D.O. increased to 5.7. mg/1. The increase in D.O. below McGrew continued through the rest of the reach studied. At Broadwater (NP-127.0) the average D.O. was at 10.5 mg/1 or 92 per cent saturation.

BIOCHEMICAL OXYGEN DEMAND (B.O.D.)

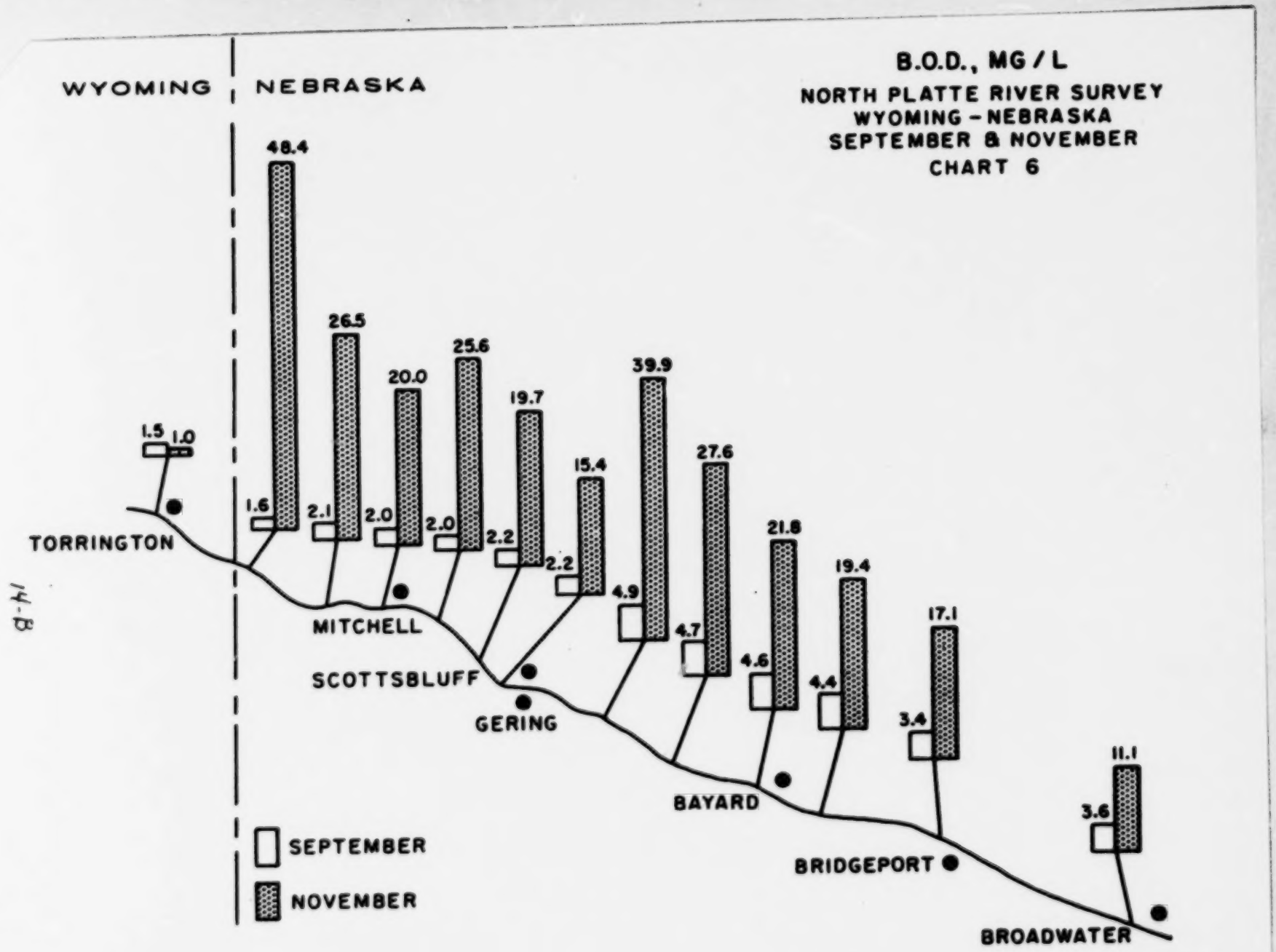
During the September study the highest average concentration of B.O.D. in the Torrington to Broadwater reach of the river was at the first station below the Scottsbluff-Gering Area. With the exception of the reach of river below Scottsbluff-Gering-Terrytown, the river carried loads of B.O.D. usually found in a relatively clean stream.

Average B.O.D. values at each stream station for the September and November studies are presented in Table 4 in mg/1 and thousands of pounds per day.

At the first station below the Scottsbluff-Gering-Terrytown Area (NP-166.0) the B.O.D. was 4.9 mg/1 or 12,120 pounds per day. From Minatare (NP-166.0) the concentrations decreased, however the load continued to increase through the rest of the reach. The increased load was due to the B.O.D. carried by the irrigation return water.

Chart 6 presents average B.O.D. results for September and November in mg/1 at each of the river stations. The average B.O.D. loads in pounds per day carried by the river during the two studies are presented in Chart 7.

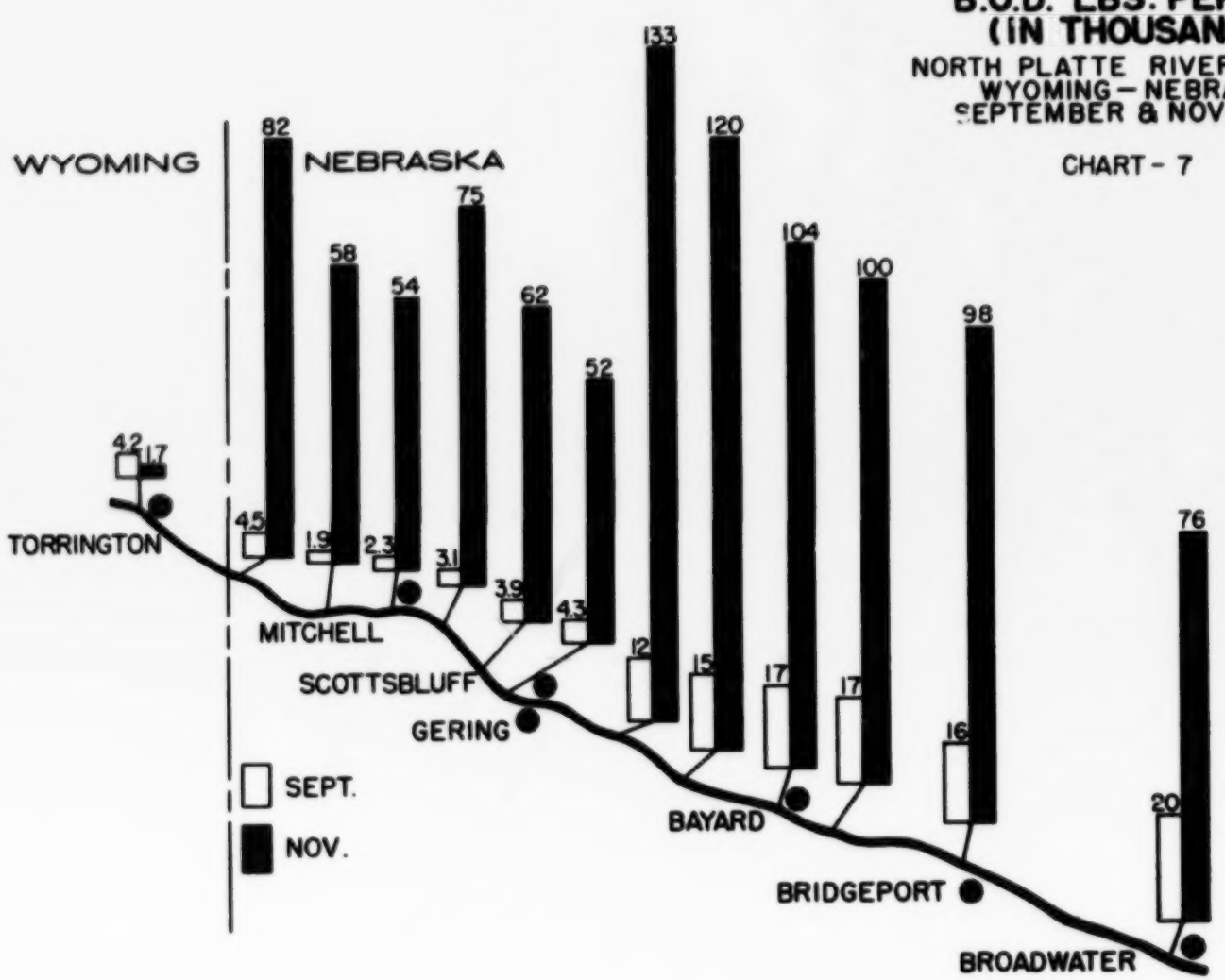
B.O.D. data on each plant waste in Table 5 includes the concentration in mg/1, pounds per day, population equivalents, and pounds of B.O.D. per ton of beets processed.


B.O.D., MG/L
NORTH PLATTE RIVER SURVEY
WYOMING - NEBRASKA
SEPTEMBER & NOVEMBER
CHART 6
WYOMING
NEBRASKA
TORRINGTON
MITCHELL
SCOTTSBLUFF
GERING
BAYARD
BRIDGEPORT
BROADWATER
1.5
1.0
48.4
1.6
26.5
2.1
20.0
2.0
25.6
2.0
19.7
2.2
15.4
2.2
39.9
4.9
27.6
4.7
21.8
4.6
19.4
4.4
17.1
3.4
11.1
3.6
SEPTEMBER
NOVEMBER

B.O.D. LBS. PER DAY
(IN THOUSANDS)

NORTH PLATTE RIVER SURVEY
WYOMING – NEBRASKA
SEPTEMBER & NOVEMBER

CHART - 7



During November at the Torrington Station (NP-208.8), above the sources of wastes considered, the B.O.D. averaged 1.0 mg/l and the load amounted to 1,710 pounds per day. The load was 41 per cent of the September load in the river. This indicates the reduced irrigation return loads during November.

Immediately below the Torrington Bridge Station the Holly Torrington plant discharged its wastes (HT-208.8). The B.O.D. discharged during the 4-day sampling period averaged 1,360 mg/l or 103,000 pounds per day, at an average flow of 14.11 cfs. The total calculated load in the river immediately below this discharge was 104,700 pounds per day or 61 mg/l.

At Henry (NP-199.0) the average B.O.D. concentration was 48.4 mg/l and the load 82,200 pounds per day. This represents an average reduction of 22,500 pounds of B.O.D. between the point of waste discharge and Henry.

At Mitchell (NP-184.0) the average load was 53,500 pounds of B.O.D. per day and the concentration 20.0 mg/l. Approximately 97 per cent of this amount, or 52,000 pounds was residual B.O.D. from the Torrington Holly plant.

At the Scottsbluff-Gering Bridge the B.O.D. load was 51,500 pounds per day and the concentration 15.4 mg/l. Calculations based on a deoxygenation coefficient of 0.42 indicate that about 15,500 pounds of B.O.D. settled to the bottom of the river between the Mitchell Bridge and the Scottsbluff-Gering-Terrytown Bridge. This represented about 23 per cent of the residual B.O.D. at the Scottsbluff-Gering-Terrytown Bridge Station. Assuming that the B.O.D. from above Mitchell settled proportionately the

residual quantity was 31,500 pounds. About 30,500 pounds of this B.O.D. originated at the Holly Torrington plant.

In the Scottsbluff-Gering-Terrytown Area an additional load of 124,000 pounds per day of B.O.D. was discharged to the river. The Great Western plant at Scottsbluff contributed 99,000 pounds, and the Gering plant 16,500 pounds per day. The remaining 8,500 pounds were contributed by the other wastes from this area. The total load being carried by the river below the bridge was calculated to be 175,000 pounds per day. With an average flow of 627 cfs the calculated concentration was 52 mg/l.

At the Minatare Station (NP-166.0) the average B.O.D. concentration was 33.9 mg/l and the load 132,700 pounds per day. The McGrew Bridge Station (NP-160.2) had a concentration of 27.6 mg/l and a load of 120,000 pounds. At the Bayard Bridge (NP-154.6) these figures were 21.8 mg/l or 104,200 pounds.

The Bayard plant wastes were discharged below the Bayard Bridge and upstream from the Belmont Diversion Dam (NP-149.8). The B.O.D. concentration at the dam was 19.4 mg/l and the load 99,600 pounds per day. Though there was a decrease in the B.O.D. load the rate of decrease was somewhat less than upstream. Part of the apparent decrease in rate was due to the load discharged from the Bayard Plant broad-field irrigation system. In addition the actual deoxygenation rate decreased in this section of the river.

By the use of formulae included in Appendix B the B.O.D. remaining from any source can be calculated at any downstream point within the reach of the river studied. These calculated results are presented in Table 7 for B.O.D. loads greater than 1,000 pounds per day.

NORTH PLATTE RIVER SURVEY

Wyoming-Nebraska

September and November 1961

TABLE No. 7

SOURCES OF WASTE

BOD-Residuals (of Sources Greater than 1,000 Lbs/day)

BOD in Lbs/day Remaining At Station	*Holly Sugar	*Gr.West. Mitchell Plant	Scotts-bluff Munic. Waste	Gering Munic. Waste	*Gr.West. Scotts-bluff Plant	*Gr.West. Gering Plant	Gr.West. Bayard Plant	Total Load in River
* (HT-208.8) →	*103,000							104,700
(NP-199.0)	81,000							82,200
(NP-191.6)	57,000							58,000
(NP-184.0)	52,500							53,500
*(GM-184-1.5) →		*35,000						88,000
(NP-180.5)	45,000	29,700						75,000
(NP-177.3)	37,000	24,400						61,500
(NP-173.8)	30,500	20,500						51,500
Scottsbluff →			3,000					-
Municipal								
Gering →				6,000				-
Municipal								
*(GS-173.8-3.0) →					99,000			-
*(GG-173.0-1.5) →						*16,400		176,000
(NP-166.0)	24,800	16,600	2,400	4,800	80,000	13,000		132,700
(NP-160.2)	21,200	14,000	2,000	4,150	68,000	11,000		120,000
(NP-154.6)	18,200	12,200	1,790	3,580	59,000	9,800		104,200
(GB-150.0-2) →							9,200	-
(NP-149.8)	17,300	11,200	1,650	3,300	54,500	9,050	9,200	99,600
(NP-141.8)	15,200	9,850	1,450	2,900	48,000	7,950	7,450	97,600
(NP-127.0)	12,000	7,100	1,130	2,260	37,200	6,200	5,800	76,000

* Loads from field data.

During the November study a total of 267,000 pounds per day of 5-day 20° C. Biochemical Oxygen Demand were discharged to the North Platte River between Torrington, Wyoming and Broadwater, Nebraska. Of this amount the five beet sugar plants discharged 255,700 pounds and the remaining sources of waste accounted for 11,300 pounds. One hundred and three thousand of the 255,700 pounds were discharged from the one beet sugar plant in Wyoming. One hundred and fifty-two thousand seven hundred pounds were discharged in the combined wastes of the four sugar plants in Nebraska. Of the remaining 11,300 pounds approximately 9,000 pounds were discharged from the Scottsbluff-Gering Area.

BACTERIOLOGY

Bacteriological examination of stream and waste samples included determination of bacteria of the coliform group, fecal coliform, and fecal streptococci. The purpose and procedure of each of the bacteriological tests performed is included in Appendix C under the heading, "Bacteriological Examination of Stream Samples."

Chart 8 presents the procedures used during the September and November studies. Individual results obtained on each daily sample are included in Appendix A. Average bacteriological results for each of the stations are summarized in Table 8.

Table 8 presents the average results for the coliform group in most probable numbers (MPN) per 100 milliliters in thousands. These data are also presented in Bacterial Quantity Units, and Bacterial Population Equivalents. The Bacterial Quantity Units (B.Q.U.) represent the number of bacteria that will pass any given point on a stream in one day.

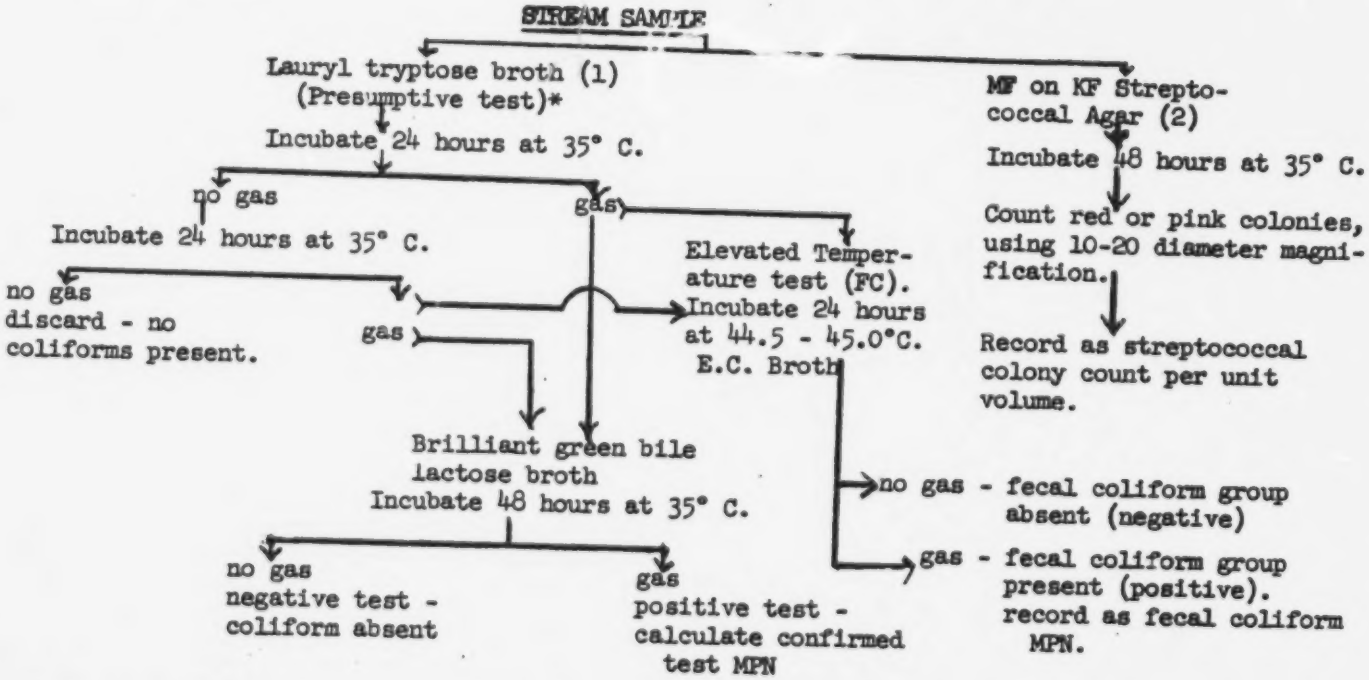
NORTH PLATTE RIVER SURVEY

Wyoming-Nebraska

September and November 1961

CHART No. 8

BACTERIOLOGICAL EXAMINATION OF STREAM SAMPLES



* Indicates procedure described as standard test in Standard Methods for the Examination of Water and Wastewater, 11th ed. (1960).

(1) Lactose broth may be substituted for lauryl tryptose broth.
(2) The KF Agar pour plate count may be used interchangeably with the MF colony counting technique.

Produced by: Microbiology Section
Research Branch
WSPC

17-8

One (1) B.Q.U. equals 2.45×10^{12} (2 trillion, 450 billion) bacteria going by a point in a 24-hour period. Bacterial Population Equivalents were calculated on the basis of the maximum coliform contribution per capita at the peak of the coliform growth curve.

Table 8 includes data on fecal coliform MPN per 100 ml in thousands, and B.Q.U. Units. Streptococci is recorded as FS per 100 ml, and in B.Q.U. Units.

Average bacterial results of each of the river stations are presented in Charts 9 through 14. Chart 9 presents the total coliform in MPN per 100 ml; Chart 10 the total coliform in B.Q.U. Units. Chart 11 presents the fecal coliform in MPN per 100 ml; Chart 12 fecal coliform in B.Q.U. Units. Chart 13 presents the streptococci bacteria in density per 100 ml; Chart 14 the streptococci in B.Q.U. Units.

Coliform Group Bacteria

Coliform content of the North Platte at the Torrington Station (NP-208.8), was relatively low during September and November. In September the concentration was 800 coliform per 100 ml, and in November 70 coliform per 100 ml. The higher figure in September was probably due to irrigation return water.

At the Henry Station (NP-199.0), below the Holly Sugar plant waste discharge, there was a thousandfold increase during November as compared to a 3.5-fold increase in September over the content at the Torrington station.

Horse Creek (HC-194-1) a tributary receiving the untreated wastes of Lyman contributed approximately one-third of the total coliform at

NORTH PLATTE RIVER SURVEY
WYOMING-NEBRASKA
SEPTEMBER-AND NOVEMBER 1961

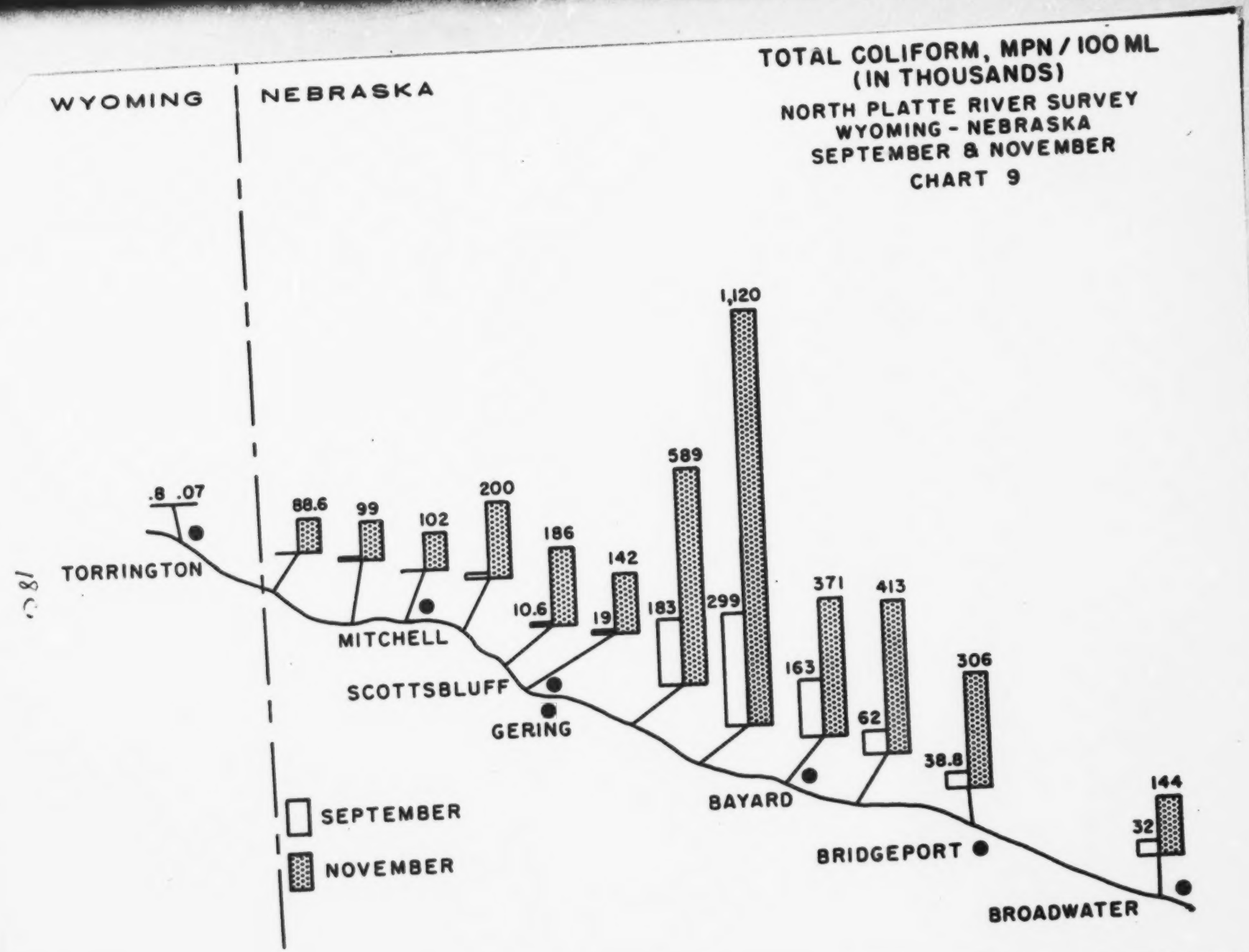
SUMMARY BACTERIOLOGICAL DATA TABLE No. 8

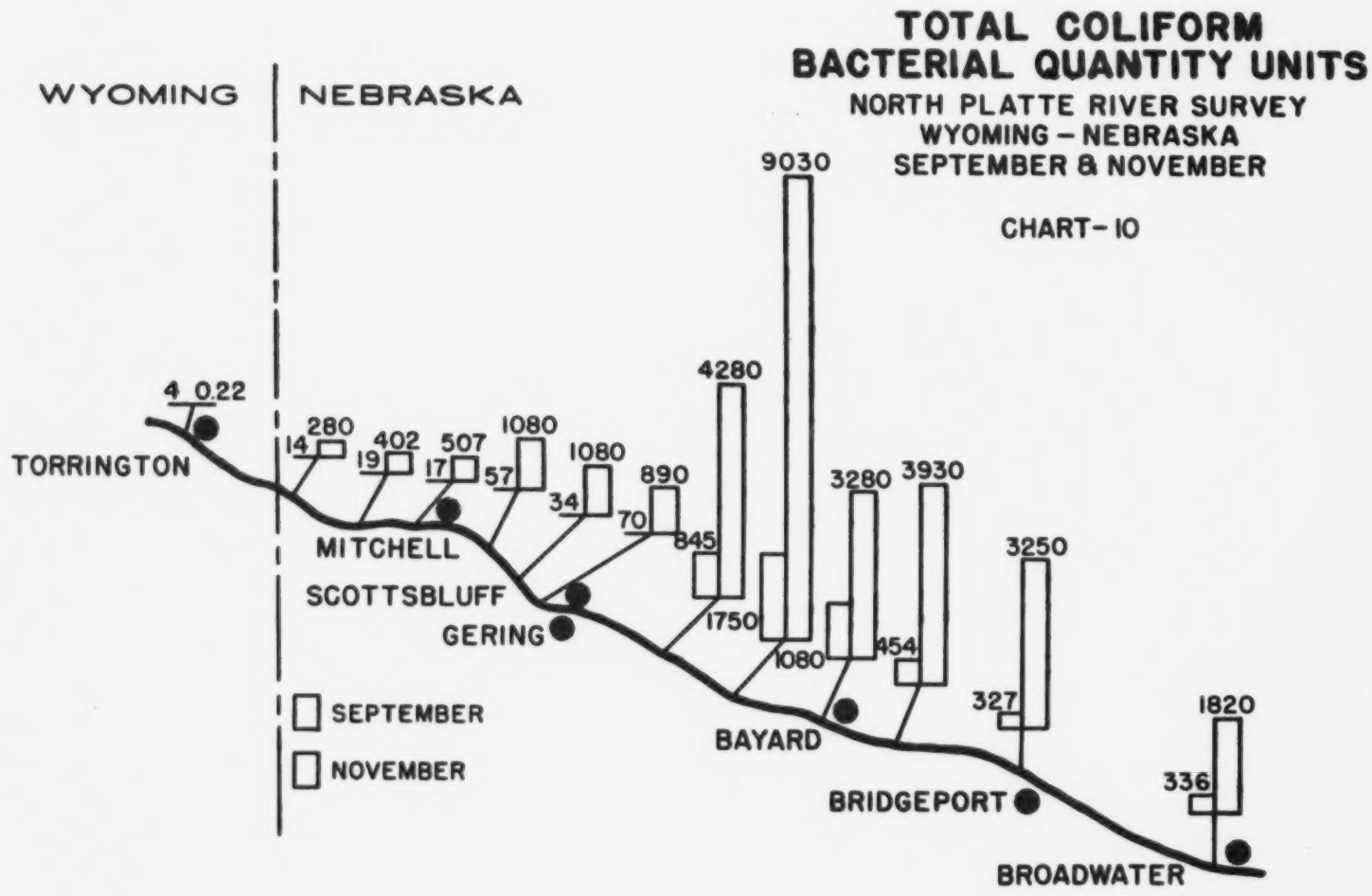
Station	Flow (Cfs) SEPT.	NOV.	TOTAL COLIFORM SEPTEMBER MPN/100ml (in thous.)	BQU(3)	BPE(4)	NOVEMBER MPN/100 ml (in thous.)	BQU(3)	BPE(4)	FECAL COLIFORM SEPTEMBER MPN/100ml (in thous.)	BQU(3)	NOVEMBER MPN/100ml. (in thous.)	BQU(3)	FECAL STREP SEPTEMBER FS/100 ml (in thous.)	BQU(3)	NOVEMBER MPN/100 ml (in thous.)	BQU(3)
NP 208.8	528	317	.8	4	103	.07	.22	5.4	< .44	< 2.3	.04	.12	.032	.17	.17	.54
NP 199.0	528	317	2.6	14	336	88.6	280	6,880	< .35	< 1.8	4.73	15	.146	.77	1,477	4,680
(1)NC 194-1	56	27	10	6	137	14.7	4	97	3.7	2.0	3.3	.89	1.6	.90	38	10
NP 191.6	171	406	11.2	19	469	99	402	9,850	1.9	3.2	2.1	8.5	1.1	1.9	704	2,860
NP 184.0	212	497	7.9	17	410	102	507	12,420	2.7	5.7	2.4	12	.74	1.6	264	1,310
NP 180.5	284	541	20.2	57	1,400	200	1,080	26,510	6.4	18	15.2	82	.8	2.3	301	1,630
NP 177.3	324	582	10.6	34	841	186	1,080	26,520	1.3	4.2	5.4	31	1.0	3.2	208	1,210
NP 173.8	367	627	19	70	1,710	142	890	21,810	2.9	10.6	8.0	50	1.4	5.1	278	1,740
NP 166.0	462	726	183	845	20,700	589	4,280	104,770	38.5	178	39	283	5.6	26	1,625	11,800
NP 160.2	585	807	299	1,750	42,900	1,119	9,030	221,240	37.0	216	27.7	224	5.8	34	1,189	9,600
NP 154.6	665	884	163	1,080	26,600	371	3,280	80,350	50.0	333	48.0	424	5.5	37	579	5,120
NP 149.8	733	951	62	454	11,100	413	3,930	96,230	14.8	108	23.0	219	2.7	20	406	3,860
(1)NW 149.3-0.5	145	72	38.8	56	1,400	15.7	11	277	12.5	18	6.2	4.5	6.1	8.8	12.6	9.1
NP 141.8	843	1062	38.8	327	8,000	306	3,250	79,620	8.9	75	16.2	172	3.0	25	280	2,970
NP 127	1,050	1267	32	336	8,200	144	1,820	44,700	1.7	18	4.7	60	9.5	100	63.3	802
(2)OG 173-1.5	0.55	10.96	251	1.4	34	11,601	1,270		194.5	1.1	193	21	73	.40	40,121	4,400
(2)HP 208.8	-	14.05	-	-	-	7,039	989		-	-	89	12	-	-	132,692	18,700
(2)GM 184-1.5	-	9.85	-	-	-	50,057	4,930		-	-	1,548	152	-	-	8,321	820
(2)GS 173.8-1.5	-	13.14	-	-	-	3,307	435		-	-	159	21	-	-	20,241	2,660
(2)GB 150-2.5	-	8.0	-	-	-	8,141	651		-	-	70.4	5.6	-	-	16,000	1,280
(2)GB 150-2.0	-	2.4	-	-	-	1,928	46		-	-	20.0	.48	-	-	1,444	36

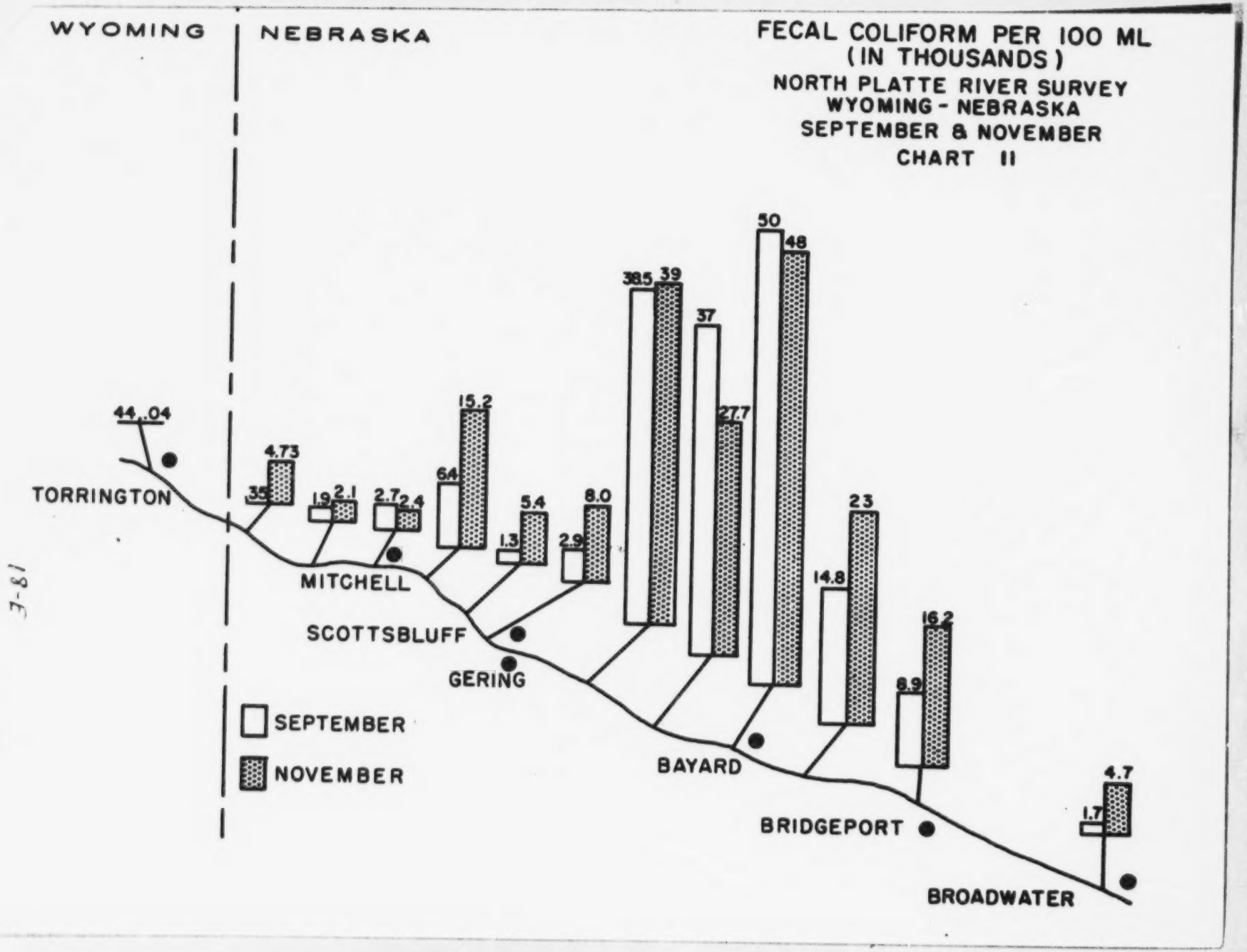
(1) Tributary Stations.
(2) Beet Sugar Plant Waste Ditch Stations.
(3) Bacterial Quantity Units (BQU) = $\frac{\text{Bacteria/100 ml x flow (CFS)}}{10^5}$

(4) BPE(Bacteria) Population Equivalent) - Based on Temperatures of Less than 15°C.-BPE = Flow(CFS) x MPN/100 ml x 2.45×10^{-4}.

4-81


TOTAL COLIFORM, MPN / 100 ML
(IN THOUSANDS)
NORTH PLATTE RIVER SURVEY
WYOMING - NEBRASKA
SEPTEMBER & NOVEMBER
CHART 9
WYOMING
NEBRASKA
.8
.07
TORRINGTON
88.6
99
102
MITCHELL
200
186
10.6
142
19
SCOTTSBLUFF
GERING
589
183
1,120
299
BAYARD
371
163
413
62
306
38.8
144
32
BRIDGEPORT
BROADWATER
SEPTEMBER
NOVEMBER

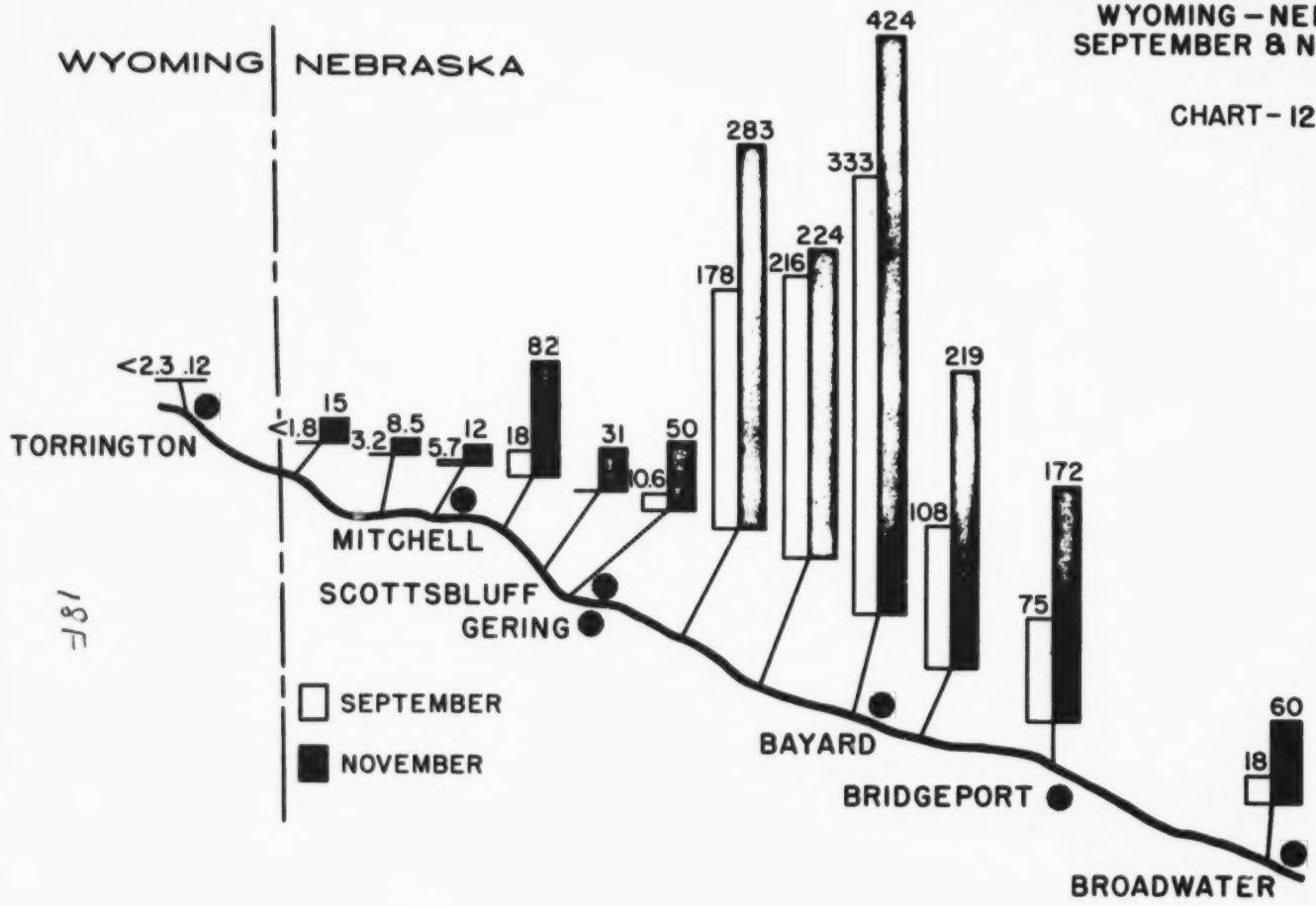

TOTAL COLIFORM
BACTERIAL QUANTITY UNITS
NORTH PLATTE RIVER SURVEY
WYOMING – NEBRASKA
SEPTEMBER & NOVEMBER
CHART-10
WYOMING
NEBRASKA
TORRINGTON
MITCHELL
SCOTTSBLUFF
GERING
BAYARD
BRIDGEPORT
BROADWATER
4
0.22
14
280
19
402
17
507
57
1080
34
1080
70
890
845
4280
1750
9030
1080
3280
454
3930
327
3250
336
1820
SEPTEMBER
NOVEMBER


WYOMING
NEBRASKA
FECAL COLIFORM PER 100 ML
(IN THOUSANDS)
NORTH PLATTE RIVER SURVEY
WYOMING - NEBRASKA
SEPTEMBER & NOVEMBER
CHART II
44
.04
TORRINGTON
35
4.73
1.9
2.1
2.7
2.4
MITCHELL
64
15.2
1.3
5.4
2.9
8.0
SCOTTSBLUFF
GERING
38.5
39
37
27.7
50
48
14.8
23
8.9
16.2
BAYARD
BRIDGEPORT
1.7
4.7
BROADWATER
SEPTEMBER
NOVEMBER
3-81

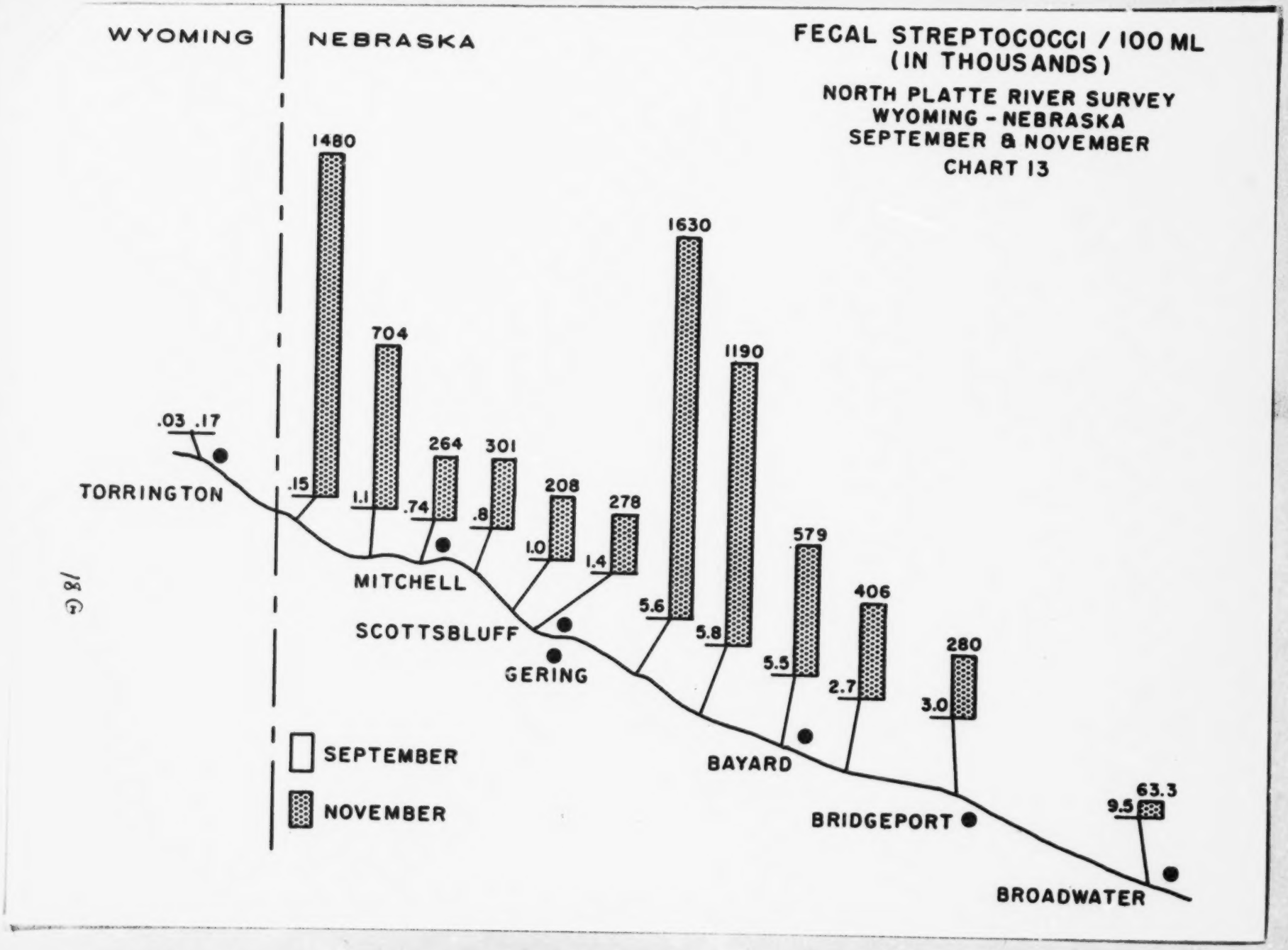
FECAL COLIFORM BACTERIAL QUANTITY UNITS

NORTH PLATTE RIVER SURVEY
WYOMING – NEBRASKA
SEPTEMBER & NOVEMBER

CHART – 12



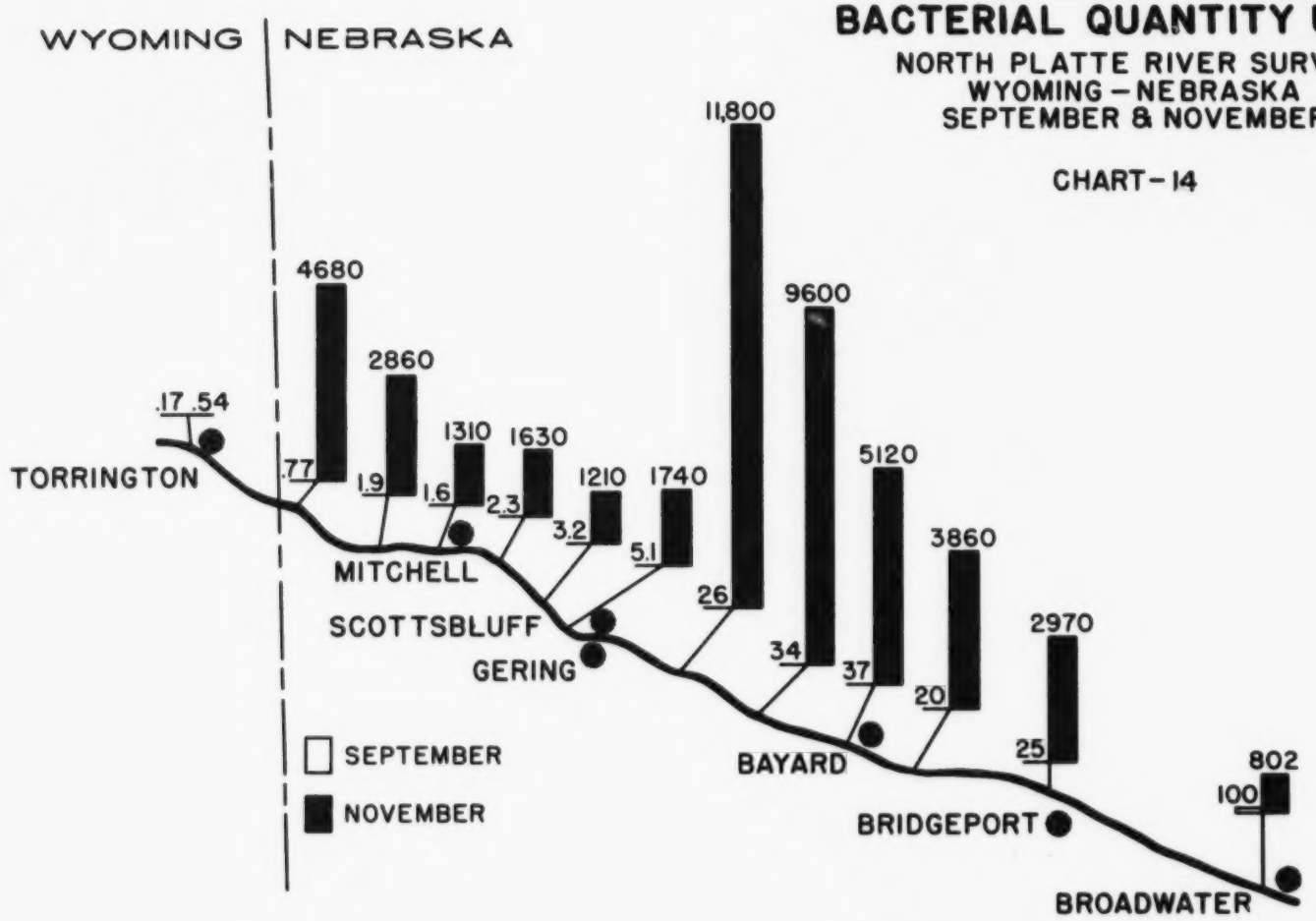
-181


WYOMING
NEBRASKA
FECAL STREPTOCOCCI / 100 ML
(IN THOUSANDS)
NORTH PLATTE RIVER SURVEY
WYOMING - NEBRASKA
SEPTEMBER & NOVEMBER
CHART 13
1480
704
264
301
208
278
1630
1190
579
406
280
63.3
.03
.17
.15
1.1
.74
.8
1.0
1.4
5.6
5.8
5.5
2.7
3.0
9.5
TORRINGTON
MITCHELL
SCOTTSBLUFF
GERING
BAYARD
BRIDGEPORT
BROADWATER
SEPTEMBER
NOVEMBER
18

FECAL STREPTOCOCCI
BACTERIAL QUANTITY UNITS

NORTH PLATTE RIVER SURVEY
WYOMING – NEBRASKA
SEPTEMBER & NOVEMBER

CHART – 14



H-31

Morrill during September, while in November the contribution amounted to one per cent.

At Station 6 (NP-180.5) below the discharge of Mitchell sewage and Great Western's Mitchell plant, there was a marked increase both during September and November. In September the increase was from 7,900 above the wastes to 20,200 per 100 ml, and in November from 102,000 to 200,000 per 100 ml.

At the Minatare Station (NP-166.0), the first station below the Scottsbluff-Gering Area, a sharp increase occurred in densities during both studies. In September the MPN per 100 ml was 183,000. In November there were 589,000 per 100 ml. At McGrew (NP-160.2) the density continued to increase to 299,000 per 100 ml during September. The highest average recording during November also occurred at McGrew. Most probable number per 100 ml was 1,120,000.

The average values at the McGrew Bridge represent a 400-fold increase in September, and a 40,000-fold rise in November over the average values at the Torrington Station (NP-208.8).

Below the McGrew Bridge the densities dropped during the September study through the remainder of the reach studied. During November there was a drop from 1,120,000 coliforms per 100 ml at the McGrew Bridge to 371,000 per 100 ml at the Bayard Bridge (NP-154.6). However, there was an increase to 413,000 per 100 ml at the Belmont Diversion Dam (NP-149.8) below the Bayard Plant waste. Below the Belmont Dam the densities decreased to 144,000 per 100 ml at the Broadwater Station.

Red Willow Creek (RW-149.3-0.5) at the point sampled included the sewage discharged by the Bayard municipal system. The average total coliform at that station during September was 38,800 per 100 ml, and during November 15,700 per 100 ml. The decrease was probably due to the lower temperatures of November, and the reduced irrigation activities.

The five beet sugar plants contributed a total of 7,670 B.Q.U. to the river. The Torrington plant contributed 989 B.Q.U., the Mitchell plant 4,930 B.Q.U., the Scottsbluff plant 435 B.Q.U., the Gering plant 1,270 B.Q.U., and the Bayard plant 46 B.Q.U.

Fecal Coliform Bacteria

There was only a slight increase in fecal coliform densities at the various river stations during the November study as compared to the September data. Densities of less than 440 fecal coliforms per 100 ml in September and 40 per 100 ml in November were recorded at the Torrington Station. In November the densities at Henry increased to 4,730 per 100 ml, while in September there was a drop to less than 350 MPN per 100 ml.

Below the Mitchell sewage, and the Great Western plant discharge the density was 6,400 MPN per 100 ml with 18 B.Q.U. in September, and 15,200 MPN per 100 ml with 82 B.Q.U. in November.

Peak densities were recorded at the Bayard Bridge Station (NP-154.6) for both studies. For September there were 50,000 fecal coliform per 100 ml or 333 B.Q.U. During November there were 48,000 MPN per 100 ml and 424 B.Q.U. The higher B.Q.U. in the river during November indicates a definite contribution of fecal coliform from the beet sugar plants.

Fecal coliform densities in Horse Creek below Lyman wastes were 3,700 per 100 ml during September, and 3,300 per 100 ml during November. The B.Q.U. dropped from 2.0 during September to 0.89 during November.

At the Red Willow Station below the Bayard sewage discharge the fecal coliform dropped from 12,500 MPN per 100 ml during September to 6,200 per 100 ml during November.

Data obtained from the beet sugar plant waste ditches indicate that a total fecal coliform of 206 B.Q.U. were discharged to the river from the five plants. The Torrington plant discharged 12 B.Q.U., the Mitchell plant 152, the Scottsbluff plant 21, the Gering plant 21, and the Bayard plant 0.48 B.Q.U.

Fecal Streptococci Bacteria

The group of streptococci investigated during the September and November studies are always found in feces. Fecal Streptococci, like fecal coliform are interpreted to indicate fecal pollution.

At the Torrington Station (NP-208.8) densities were quite low at 32 streptococci per 100 ml and 170 streptococci per 100 ml during September and November respectively.

At Henry (NP-199.0) the density was 146 streptococci per 100 ml in September and in November 1,480,000 streptococci per 100 ml. This represents a density increase of 10,000 times between September and November.

During the September study the densities increased from Henry to the Scottsbluff-Gering Bridge, where the density was 1,400 streptococci per 100 ml. During November densities dropped in this section to

a minimum of 208,000 per 100 ml, at the 20th Street Bridge (NP-177.3), and then increased to 278,000 per 100 ml at the Scottsbluff-Gering Bridge (NP-173.8).

Below the Scottsbluff-Gering-Terrytown Area sharp increases occurred during September and November. During September a density of 5,800 streptococci per 100 ml occurred at the McGrew Bridge (NP-160.2). During November the maximum density of 1,630,000 streptococci per 100 ml occurred at Minatare.

During September densities dropped from the maximum at McGrew to the Bridgeport Station below the confluence with Red Willow. At the Bridgeport Station there were 3,000 streptococci per 100 ml. At the Broadwater Station below Bridgeport wastes there were 9,500 streptococci per 100 ml.

In November streptococci densities dropped at each of the downstream stations from the maximum at Minatare to 63,300 per 100 ml at the Broadwater Station (NP-127.0).

The Holly Sugar Company plant at Torrington contributed 18,700 B.Q.U. of streptococci with 133,000,000 per 100 ml, to the river; the Mitchell plant 820 B.Q.U. with 8,320,000 per 100 ml; the Scottsbluff plant 2,660 B.Q.U. with 20,200,000 per 100 ml; the Gering plant 4,400 B.Q.U. with 40,100,000 per 100 ml; and the Bayard plant 36 B.Q.U. with 1,440,000 per 100 ml.

SUSPENDED SOLIDS

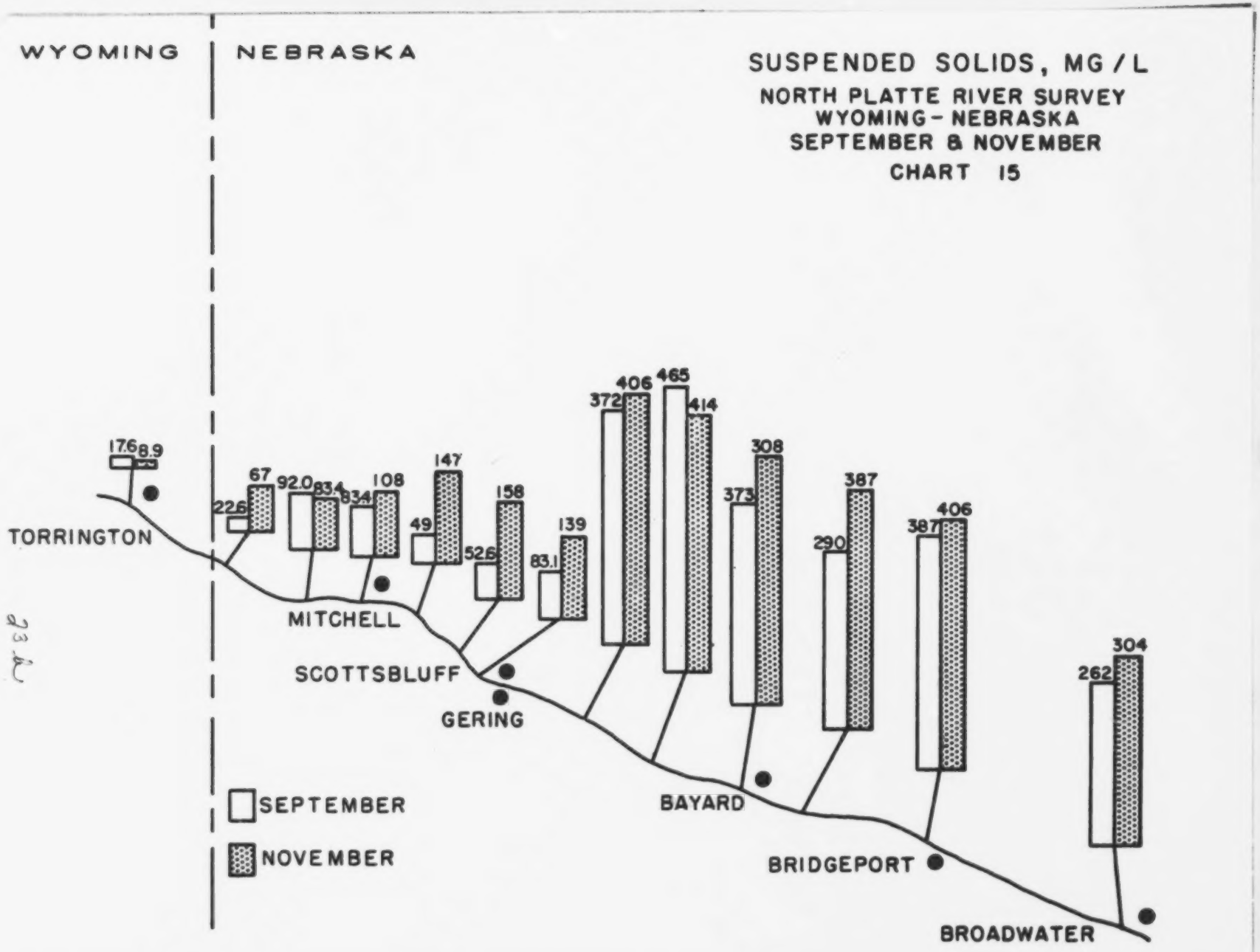
Total and volatile suspended solids data were collected during the September and November studies. Results of individual samples are

recorded in Appendix A. Average results of the individual stations for September and November are presented in Table 4.

Chart 15 presents average concentrations at each of the river stations in mg/l of suspended solids for September and November. Chart 16 presents the load in pounds per day at each of the river stations during the two studies.

During the initial study the load carried by the river increased from a load of 50,200 pounds per day at Torrington to a load of 95,400 pounds per day at the Mitchell Bridge Station (NP-184.0). The increase between stations where wastes are not known to enter indicates the source of the additional load to be the irrigation return water. Below the Mitchell Station the load dropped to 75,000 pounds per day at Station 6 (NP-180.5). From this point the load increased to the McGrew Bridge Station with a sharp rise at the first station below the Scottsbluff-Gering-Terrytown Area. From the Scottsbluff-Gering Bridge to Minatare there was an increase from 164,500 pounds to 926,000 pounds per day. At Bridgeport (NP-141.8) the concentration and load was at the highest point in the reach studied during September. The average concentration was 387 mg/l, and the average load 1,760,000 pounds or 880 tons of suspended solids per day.

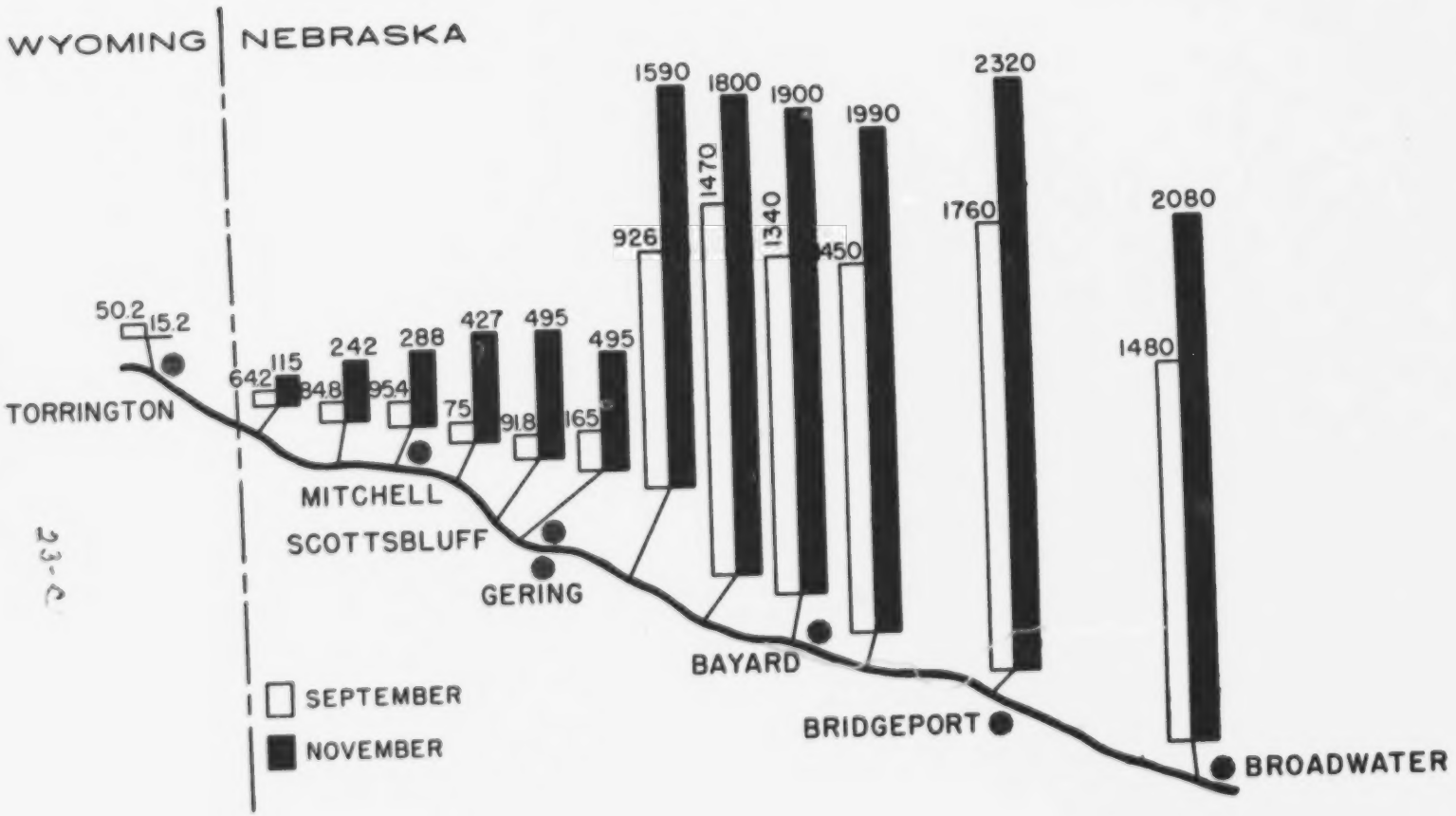
During November the concentration and load at the Torrington Station was 8.9 mg/l and the load 15,200 pounds per day. The concentration and load increased to 108 mg/l and 288,400 pounds per day at the Mitchell Bridge Station. Below Mitchell the concentration and load continued to increase to 158 mg/l and 495,000 pounds per day at the 20th Street Bridge (NP-177.3). At the Scottsbluff-Gering Bridge there was a drop to 139 mg/l and 469,000 pounds per day.


WYOMING
NEBRASKA
SUSPENDED SOLIDS, MG/L
NORTH PLATTE RIVER SURVEY
WYOMING - NEBRASKA
SEPTEMBER & NOVEMBER
CHART 15
17.6
8.9
TORRINGTON
22.6
67
92.0
83.4
83.4
108
MITCHELL
49
147
526
158
83.1
139
SCOTTSBLUFF
GERING
372
406
465
414
373
308
BAYARD
290
387
387
406
BRIDGEPORT
262
304
BROADWATER
SEPTEMBER
NOVEMBER

SUSPENDED SOLIDS, LBS./DAY (IN THOUSANDS)

NORTH PLATTE RIVER SURVEY
WYOMING – NEBRASKA
SEPTEMBER & NOVEMBER

CHART - 16



23-C

Below the Scottsbluff-Gering-Terrytown Area there was an increase of over one million pounds per day. At Minatare there were 406 mg/l and 1,590,000 pounds per day of suspended solids in the river. The Gering and Scottsbluff beet sugar plants contributed an average combined load of approximately 600,000 pounds per day. Considering the sharp increase in the load during September, and November, there appears to be an unaccounted for load of between 400,000 and 500,000 pounds per day in the Scottsbluff-Gering-Terrytown Area. Computations indicate a source or sources of flow to the river heavily laden with fixed solids.

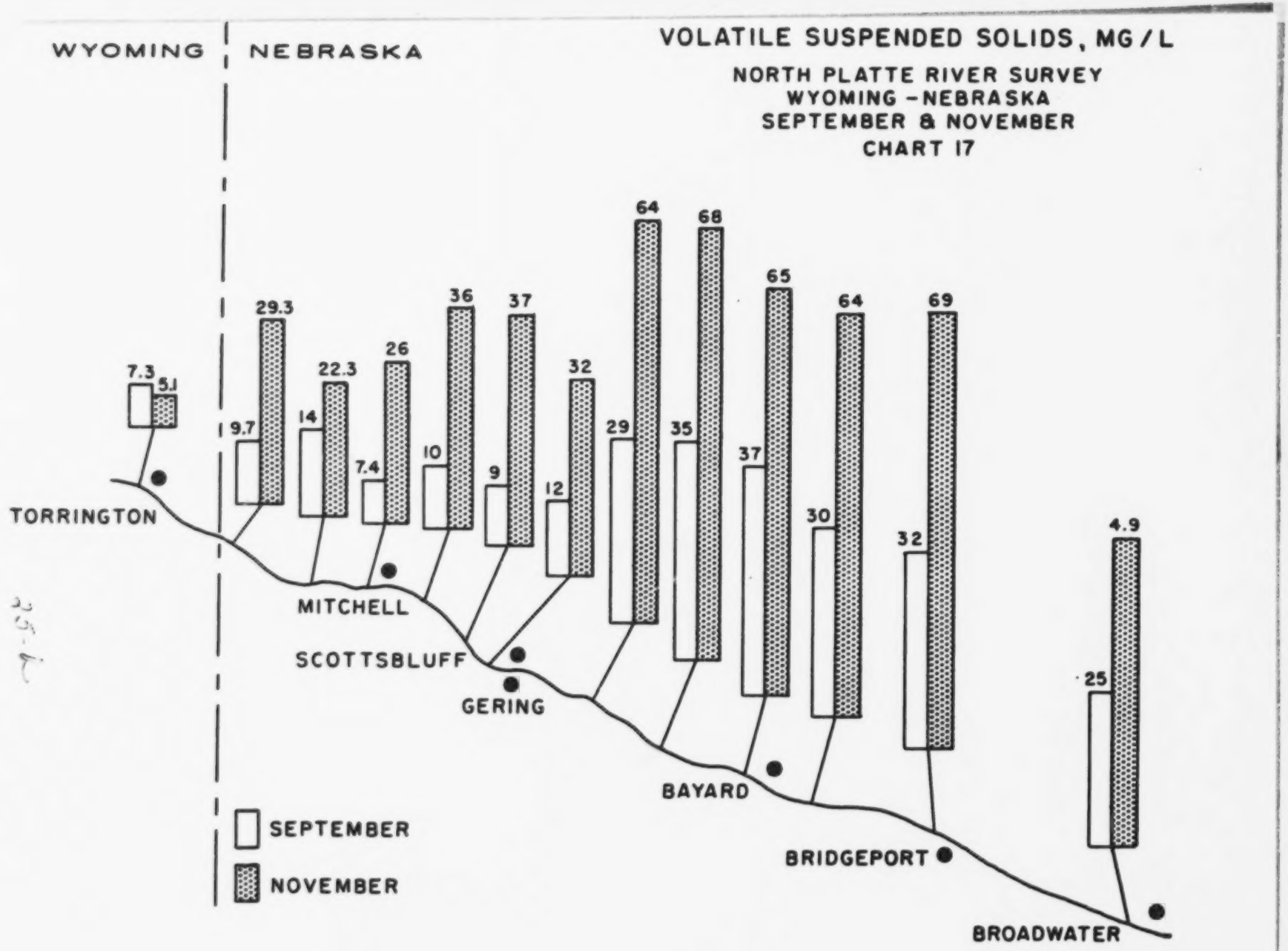
The suspended solids load in the river continued to increase during November to a maximum load of 2,320,000 pounds or 1,162 tons per day at the Bridgeport Bridge Station (NP-141.8). Below Bridgeport the load dropped to 2,080,000 pounds at Broadwater.

During the November study the five beet sugar plants discharged an average of 983,000 pounds of suspended solids per day. The Torrington plant discharged an average of 108,000 pounds with 23 per cent or 24,700 pounds as volatile suspended solids; the Mitchell plant discharged an average of 274,000 pounds per day with 17 per cent or 46,500 pounds as volatile suspended solids; the Scottsbluff plant discharged an average of 417,000 pounds per day with 16.4 per cent or 67,100 pounds as volatile suspended solids; the Gering plant discharged an average of 184,000 pounds per day with 10.6 per cent or 19,500 pounds as volatile suspended solids; and the Bayard plant discharged an average of 1,860 pounds per day with 34 per cent or 640 pounds as volatile suspended solids.

During September, irrigation activities increased the suspended solids load of the river. The load increased during November between the known sources of wastes. This would indicate that the additional flows picked up in the reach studied contributed to the increased load during both September and November. The increase from the Torrington Station to the maximum point, Bridgeport Bridge, during September amounted to 1,700,000 pounds per day. The increase between these same two points during November amounted to 2,310,000 pounds per day, or 600,000 pounds per day greater than in September. This increase occurred though the irrigation activities were considerably decreased between the September and November study periods.

Chart 17 presents the volatile suspended solids load in mg/l at each of the river stations. Chart 18 presents the load of volatile suspended solids in pounds per day at each of the river stations.

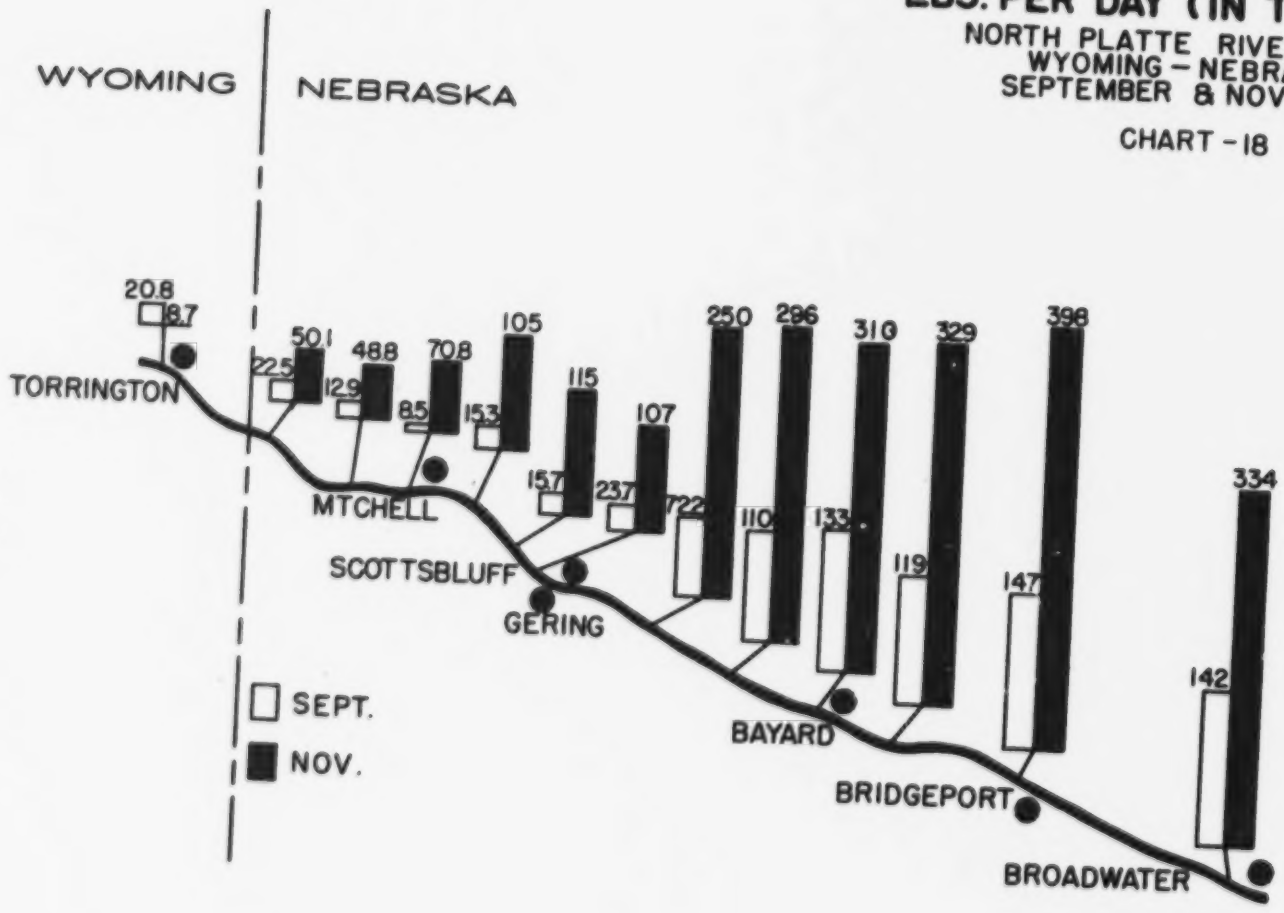
The volatile suspended matter followed the same trend as the total suspended solids. During September the increase from Torrington to the point of maximum load at Bridgeport amounted to 126,000 pounds per day, and in November the increase amounted to 389,000 pounds per day. The increased load of volatile suspended solids in the reach during September amounted to 7.35 per cent of the additional load of total suspended solids, and the increase during November amounted to 16.8 per cent of the additional suspended solids load. This indicates the increased proportion of organic matter carried in suspension during the November study.


WYOMING
NEBRASKA
VOLATILE SUSPENDED SOLIDS, MG/L
NORTH PLATTE RIVER SURVEY
WYOMING - NEBRASKA
SEPTEMBER & NOVEMBER
CHART 17
7.3
5.1
9.7
29.3
14
22.3
7.4
26
10
36
9
37
12
32
29
64
35
68
37
65
30
64
32
69
25
4.9
TORRINGTON
MITCHELL
SCOTTSBLUFF
GERING
BAYARD
BRIDGEPORT
BROADWATER
SEPTEMBER
NOVEMBER

VOLATILE SUSPENDED SOLIDS LBS. PER DAY (IN THOUSANDS)

NORTH PLATTE RIVER SURVEY
WYOMING – NEBRASKA
SEPTEMBER & NOVEMBER

CHART - 18



ALKALINITY

Alkalinity determinations were made on all samples collected during the September and November studies.

The results obtained on individual samples are presented in Appendix A. Average results for each of the stream stations are presented in Table 4. Alkalinity averages for each of the beet sugar plant wastes are included in Table 5.

Average concentrations of alkalinity were lower during November than during September. However, the load carried during November by the river was greater than that of September.

During September the load in the river increased from 546,000 to 1,480,000 pounds per day between Torrington and Broadwater. The increase amounted to 931,000 pounds of alkalinity per day. This increase during November was from 309,000 to 1,630,000 or 1,320,000 pounds per day.

The total alkalinity discharged in the combined wastes of the five beet sugar plants amounted to 82,200 pounds per day or approximately 6 per cent of the increase in the reach from Torrington to Broadwater.

HARDNESS

Hardness determinations were made on all samples collected during the September and November studies. Results of individual sample analysis are included in Appendix A. Average values of the hardness, calcium and magnesium concentrations are presented in Table 4. All concentration values are recorded as $CaCO_3$. Hardness data, including

calcium and magnesium, discharged by each of the sugar beet plants is presented in Table 5.

Hardness concentrations during November in general exceeded those of September. During September the load increased from 860,000 pounds per day at Torrington to 1,690,000 pounds per day at Broadwater. The increase amounted to 830,000 pounds of hardness per day. During November the increase was from 515,000 pounds per day at Torrington to 2,140,000 pounds per day at Broadwater, or 1,630,000 pounds per day.

The total contribution of the five sugar plants amounted to 128,200 pounds of hardness per day or 7.9 per cent of the additional load picked up in the reach studied.

SPECIFIC CONDUCTANCE

Specific conductance of natural waters is directly related to the dissolved solids content. The specific conductance, in micromhos, times 0.63 will give an approximate value of the dissolved solids content in milligrams per liter.

Average results of specific conductance obtained during September and November are recorded in Table 4 for each of the stream stations. Average results for plant wastes are recorded in Table 5.

Specific conductance did not change appreciably between September and November. The results were slightly higher during September.

CHLORIDE, SODIUM AND SULFATE

Data on chloride, sodium, and sulfate concentrations were collected during the September and November studies. Table 4 includes the average results obtained for each of the study periods.

The chloride content was low during both studies. The sources of the chlorides present are the irrigation return waters and the raw domestic sewage being discharged to the river.

Sodium concentrations decreased between September and November. The November averages were about two-thirds of the September averages.

Sulfate concentrations decreased slightly between September and November.

TURBIDITY AND TRUE COLOR

Turbidity and true color determinations were made on each sample collected during the September and November studies. The results of individual samples are presented in Appendix A. Average results for stream stations are included in Table 4, and for plant waste ditch samples in Table 5.

Average values of turbidity and true color units of the stream stations during November did not exceed the values obtained for September. The similar values obtained in the laboratory do not indicate the observed conditions existing in the stream during the two study periods. During November the river had a dark, murky appearance particularly below the beet sugar plants, whereas during September the river appeared to be quite clear.

PHYSICAL OBSERVATIONS

Visual observations of the river stations were made during the September and November studies. Sections of the river were observed during November to ascertain the mixing of wastes with the river flow.

During September the river was quite clear in general. Considerable quantities of silt and sand were observed moving with the water along the bottom of the stream bed. During this period silt and sand were the visible load being carried by the river.

During November the river was very clear at the Torrington station. Below the Holly plant discharge the river was divided with the clear flow of the upstream water on one side and a dark murky flow on the other. From below the Torrington Area the turbid murky appearance persisted throughout the reach to Broadwater.

The most severe conditions appeared below the Scottsbluff-Gering-Terrytown Area. Beet toppings and parts were observed floating and attached to fixed objects.

The aesthetic appeal was detrimentally affected in the entire reach of the North Platte from Torrington to Broadwater by the sewage and industrial wastes.

SUMMARY AND CONCLUSION

Studies of the chemical, physical, and bacteriological qualities of the North Platte River from Torrington, Wyoming to Broadwater, Nebraska were made during September and November, 1961.

During the September study raw sewage was being discharged directly to the river by 10 communities, and by two communities to tributaries. The bacterial population equivalents of the 12 communities totaled 21,720. In addition 9 industries discharged significant quantities of untreated wastes to the river during September. The 12 communities and 9 industries are all located in Nebraska, with a major concentration in the Scottsbluff-Terrytown-Gering Area. One community, Torrington, Wyoming, had adequate treatment of its sewage during the survey.

The most serious effects of the wastes on the stream during September were the high bacterial densities downstream from the Wyoming-Nebraska state line. Below the confluence of Horse Creek and the North Platte (River Mile 194) the coliform densities increased in general to a maximum density of 299,000 per 100 ml below the Scottsbluff-Terrytown-Gering Area. This is approximately 60 times the 5,000 coliform per 100 ml considered to be the acceptable limit of satisfactory water quality. The need for adequate treatment of the untreated

wastes being discharged to the river during the September study is indicated by the increased bacterial contamination below the points of discharge.

An average of less than 5.0 mg/l of 5-day 20° C. B.O.D. is accepted by a number of pollution control agencies for reasonably clean streams. Though the average values of September did not exceed the 5.0 mg/l at any of the river sampling stations the 4.9 mg/l value below the Scottsbluff-Terrytown-Gering Area was close, and one sample at the Minatare Bridge had a value of greater than 7.5 mg/l.

The suspended solids load being carried by the river increased throughout the reach studied during September. The major part of the suspended solids was added by irrigation return water. There was a sharp increase in solids below the Scottsbluff-Terrytown-Gering Area.

Though the conditions existing during September do not constitute pollution of interstate waters, the necessity of treatment for the wastes being discharged is evident.

The combined wastes of municipal and industrial sources discharged to the river during November contributed a 5-day 20° C. Biochemical Oxygen Demand load equivalent to that from a population of 1,570,000. Of these population equivalents the five beet sugar plants accounted for 1,503,000, the raw sewage discharges 21,700, and other industries 44,700.

The Holly Sugar Company Plant discharged a 5-day 20° C. B.O.D. load to the river of 103,000 pounds per day. At the state line 48.4 mg/l of B.O.D. was present in the river. Below the Scottsbluff-Terrytown-Gering Area the concentration was 33.9 mg/l. At no point below

Torrington did the river have less than 11.1 mg/l in the reach studied. Concentrations were from 2 to 10 times the 5 mg/l considered indicative of a moderately polluted stream.

As a result of the organic load present from upstream, and the loads added to the river from the Scottsbluff-Gering-Terrytown Area the dissolved oxygen content of the river was reduced to 4.5 mg/l and 4.3 mg/l at the Minatare and McGrew stations respectively. Concentrations of less than 2.5 mg/l were found in two individual samples at the McGrew Station. A minimum of 5 mg/l of dissolved oxygen is considered necessary to maintain satisfactory stream quality.

Though the low D.O. concentrations occurred below the Scottsbluff-Gering-Terrytown Area the residual B.O.D. from upstream sources contributed to the low oxygen levels. Of the computed load of 175,000 pounds per day of B.O.D. in the river immediately below the Scottsbluff-Gering-Terrytown Area 51,500 pounds per day or 34 per cent was residual B.O.D. from upstream sources. Of the 51,500 pounds per day the Holly Sugar Company plant accounted for about 30,500 pounds per day.

Extremely high concentrations of coliform bacteria were found at all river stations below Torrington during the November study. At the state line the average MPN was 88,600 coliform organisms per 100 ml. Below the state line the concentrations increased to a maximum of 1,120,000 per 100 ml below the Scottsbluff-Gering-Terrytown Area. Average concentrations below Torrington were 18 to 200 times the 5,000 coliform per 100 ml which is usually considered indicative

of reasonably satisfactory water quality.

Fecal coliform concentrations during November did not increase appreciably over the September concentrations. However there was a significant increase in the number of fecal coliform present in the river. The greater numbers with similar MPN values were due to the increased flows of November. At the state line there was an average of 15 Bacterial Quantity Units during November. This was an increase of 100 times the average units at Torrington. The total number of fecal coliform present during November at the various river stations was 1.05 to 8 times greater than the total number at the same stations during September.

At the state line the concentration was 1,480,000 streptococci per 100 ml. This concentration was 10,000 times the value of 146 streptococci per 100 ml at the state line station during September. The highest concentration of 1,630,000 streptococci per 100 ml occurred at the Minatare Bridge.

The wastes discharged to the river by the beet sugar plants contributed to the high bacterial load in the river during November. The increase in the bacterial load of November over September was extremely high for the total coliform and fecal streptococci. The increased number of fecal coliform present was sufficient to indicate a significant contribution by the plant wastes.

During November the suspended solids load in the river increased by 2,300,000 pounds per day from Torrington to Bridgeport. The five beet sugar plants discharged 980,000 pounds per day or

43 per cent of the increase. The Holly Sugar Company plant at Torrington discharged 108,000 pounds per day to the river. Concentrations of suspended solids discharged in the wastes from the Holly Sugar Company during the November 1961 study indicate that a considerable reduction has been accomplished, though the 54 tons per day were still being discharged. The load of suspended solids in the river increased from 15,200 pounds per day at Torrington to 115,000 pounds per day at the state line.

Pollution of the North Platte River was caused by municipal and industrial wastes during November by (1) causing excessively high concentrations of oxygen demanding organic matter; (2) depleting the dissolved oxygen content of the river below the minimum acceptable limit; (3) causing excessively high concentrations of bacterial indicator organisms, including those of fecal, or intestinal, origin; (4) by contributing to the excessive suspended solids load; and (5) by destroying the aesthetic value of the river from Torrington to Broadwater.

Irrigation return and natural surface water contributed significant quantities of hardness, alkalinity, sulfates, and suspended solids to the river during the two study periods.

Pollution of the North Platte River at the Wyoming-Nebraska state line by the Holly Sugar Company plant at Torrington, Wyoming is evident. The pollution originating in the State of Wyoming seriously damaged the water quality at the state line, and the residuals of this pollution, along with the added wastes in Nebraska, contributed to the degraded quality of the 82-mile reach of the river studied.

The condition of the North Platte River had not improved between the study of December 1960, and the studies of September and November 1961. In addition, little if any improvement had occurred since studies conducted in 1950, except the reduction of solids being discharged by the Holly Sugar Company plant at Torrington, and a slight reduction of the organic load present in the river below the Scottsbluff-Gering Area.

Pollution by the Holly Sugar Company plant at Torrington, Wyoming constitutes interstate pollution, subject to abatement under the Federal Water Pollution Control Act, since the health and welfare of persons, in a state other than that in which the pollution originates, is endangered.

APPENDIX A

RESULTS OF INDIVIDUAL SAMPLES

NORTH PLATTE RIVER SURVEY
WYOMING - NEBRASKA
SEPTEMBER & NOVEMBER 1961
RESULTS OF ANALYSES

STATION 1 (MP208.8)

Month	Date	Sample Time	Temp. °C	D.O. mg/l	B.O.D. mg/l	Susp. Solids mg/l	Volatile Susp. Solids mg/l	pH	Alkal. Phenol mg/l (as $CaCO_3$)	Alkal. Total mg/l (as $CaCO_3$)	Cl⁻ mg/l	Hard. mg/l	Ca. mg/l	Mg. mg/l	Specf. Conduct. µmhos/cm.	True Color Units	Turb. Units	Coli. M.P.N. Per 100 ml.	Fecal Coli M.P.N Per 100 ml.	Fecal Strep Per 100 ml.
9	22	08 00A	10	8.58	1.22	25.0	6.0	8.0	0	184	17.1	306	200	106	666	8	*25			50
9	23	11 15A	12	9.23	1.16	18.0	15.0	8.3	0	187	17.3	310	203	107	657	8	*25	3,300	2,300	38
9	24	07 50A	10	8.71	0.96	22.0	4.0	8.1	0	182	16.9	302	200	102	690	8	*25	1,300	*200	75
9	25	10 00A	12	9.30	1.29	15.5	5.5	8.1	0	195	16.1	298	203	95	705	5	*25	50	20	17
9	26	11 45A	14	9.10	2.67	14.5	9.5	8.2	0	196	14.2	298	215	83	725	5	*25	40	*20	4
9	27	11 25A	15	9.34	1.83	17.0	11.0	8.2	0	206	16.3	300	204	96	720	8	*25	130	20	22
9	28	08 30A	10	8.98	1.30	11.5	0.0	8.1	0	197	16.4	301	204	97	720	8	*25	80	70	19
AV			12	9.03	1.50	17.6	7.3	8.1	0	192	16.2	302	204	98	697	7	*25	800	*438	34
11	07	07 40A	04	10.23	0.95	19.6	9.6	8.1	0			306			690	7	*25	80	50	70
11	08	11 03A	06	11.10	1.00	5.6		8.2	0			299			725	8	*25	70	20	50
11	09	06 50A	04	9.78	1.41	21.2	1.6	8.1	0	176		306			705	7	*25	110	50	43
11	10	10 30A	07	10.54	0.80	6.0	2.0	8.3	0	174		298			741	4	*25	*20	*20	48
11	11	06 35A	05	9.39	1.07	4.4	4.0	8.1	0	175		304			700	7	*25	20	*20	108
11	12	10 00A	06	10.71	1.12	10.0	4.8	8.2	0	176		302			666	7	*25	50	50	38
11	13	07 00A	04	10.18	1.00	8.8	0.4	8.1	0	176		300			770	7	*25	70	20	240
11	14	10 25A	04	11.21	0.83	3.2	2.8	8.1	0	174		300			752	7	*25	70	*20	44
11	15	07 05A	04	10.00	0.50	5.7	4.0	8.0	0	176		297			705	7	*25	80	50	124
11	16	03 35P	C5	12.00	1.51	4.4	4.4	8.2	0	170		292			690	7	*25	*20	*20	28
11	17	12 50P	04	11.57	0.91	6.5	6.5	8.0	0	174		297			668	7	*25	50	*20	1,400
11	18	09 30A	04	10.89	1.11	9.7	6.3	8.1	0	174		300			690	7	*25	80	*20	150
11	19	03 15A	03	10.10	1.00	9.0	9.0	8.1	0	173		297			741	3	*25	50	50	102
11	20	05 10A	01	10.58	0.95	10.7	10.7	8.1	0	174		299			683	7	*25	110	20	140
AV			4	10.6	1.0	8.9	5.1	8.2	0	174		300			710	7	*25	70	39	170

* Indicates less than

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SEPTEMBER & NOVEMBER 1961
RESULTS OF ANALYSES

STATION 2 (RP199.0)

Month	Date	Sample Time	Temp °C	D.O. mg/l	B.O.D mg/l	Susp. Solids mg/l	Volatile Susp Solids mg/l	pH	Alkal. Phenol mg/l (as $CaCO_3$)	Alkal. Total mg/l (as $CaCO_3$)	Cl⁻ mg/l	Hard. mg/l	Ca. mg/l	Mg. mg/l	Specf. Conduct µmhos/cm.	True Color Units	Turb. Units	Coli. M.P.N. Per 100 ml.	Fecal Coli M.P.N Per 100 ml	Fecal Strep Per 100 ml.
9	22	08 30A	10	8.95	1.41	27.0	4.0	8.0	0	196	18.4	298	196	102	700	9	30			470
9	23	10 35A	11	9.41	1.09	30.0	16.0	8.2	0	198	18.0	305	188	117	680	9	25	1,400	400	120
9	24	08 20A	10	8.99	1.24	25.0	4.0	8.2	0	194	17.7	302	188	114	715	10	30	10,900	1,400	290
9	25	10 25A	11	9.69	2.11	17.5	6.5	8.1	0	206	17.5	299	203	96	752	6	*25	1,300	*200	46
9	26	12 10P	14	9.60	2.39	19.5	10.5	8.2	0	214	19.8	302	198	104	764	8	*25	330	80	20
9	27	11 55A	14	9.81	1.54	29.0	22.0	8.3	0	213	17.1	304	197	107	752	7	*25	230	80	8
9	28	08 50A	10	9.34	1.25	10.0	5.5	8.3	0	213	17.3	301	196	145	770	9	*25	1,720	130	74
AV			11	9.39	1.6	22.6	9.7	8.1	0	204	17.9	301	186	112	733	8	*26	2,600	*348	146
11	07	08 20A	4	8.38	52.4	56.	22.	7.9	0			300			740	16	40	130,000	11,000	1,700,000
11	08	10 32A	6	8.50	41.1	63.	25.	8.0	0			304			834	13	35	221,000	3,300	390,000
11	09	07 20A	4	7.75	44.5	96.	31.	7.9	0	197		302			775	13	40	240,000	7,000	3,300,000
11	10	09 00A	6	7.60	47.1	53.	5.	8.0	0	196		299			832	13	40	172,000	4,000	1,500,000
11	11	07 05A	6	6.42	52.9	55.	28.	7.9	0	197		300			769	14	55	278,000	2,000	2,300,000
11	12	09 35A	6	7.89	49.7	60.	24.	8.0	0	196		302			769	16	45	141,000	8,000	3,400,000
11	13	07 30A	4	8.21	44.6	61.	21.	8.0	0	197		293			848	14	50	79,000	2,000	400,000
11	14	09 35A	4	8.51	44.7	71.	27.	7.8	0	196		300			763	13	65	175,000	4,000	940,000
11	15	07 35A	4	7.90	55.4	59.	27.	7.9	0	196		295			807	13	45	130,000	*2,000	600,000
11	16	3 00P	4	8.90	61.2	76.	37.	8.0	0	200		296			790	13	55	33,000	*2,000	460,000
11	17	01 20P	4	8.64	61.8	49.	28.	7.8	0	199		301			770	13	45	172,000	8,000	340,000
11	18	09 00A	3	8.54	46.8	90.	37.	7.8	0	198		300			690	14	40	490,000	*2,000	1,250,000
11	19	03 40A	3	8.01	46.6	85.	54.	7.8	0	199		294			840	14	50	49,000	4,000	8,000
11	20	04 40A	1	8.41	75.4	74.	44.	8.0	0	194		297			683	14	55	330,000	*2,000	3,500,000
AV			4	8.1	48.4	67.0	29.2	7.9	0	197		298			779	14	47	88,571	4,730	1,477,142

* Indicates less than

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NORTH PLATTE RIVER SURVEY
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RESULTS OF ANALYSES

STATION 3 (WC194-3)

Month	Date	Sample Time	Temp. °C	D.O. mg/l	B.O.D. mg/l	Susp. Solids mg/l	Volatile Susp. Solids mg/l	pH	Alkal. Phenol mg/l (as CaCO3)	Alkal. Total mg/l (as CaCO3)	Cl⁻ mg/l	Hard. mg/l	Ca. mg/l	Mg. mg/l	Spect. Conduct. µmhos/cm.	True Color Units	Turb. Units	Coli. M.P.N. Per 100 ml.	Fecal Coli M.P.N Per 100 ml	Fecal Strep. Per 100 ml.
9	22	09 10A	09	8.98																8,600
9	23	10 10A	10	10.06														11,000	*2,000	670
9	24	08 40A	10	9.41														22,000	2,000	670
9	25	10 50A	11	10.31														54,200	1,400	400
9	26	12 30P	15	9.91	2.82	75.0	18.0	8.4	5.2	416	31.8	178	128	50	1235	28	100	10,900	10,900	260
9	27	12 15P	14	10.18	2.56	67.0	23.0	8.5	8.0	416	31.8	178	116	62	1220	26	75	7,000	4,900	150
9	28	09 10A	10	9.72	1.94	60.0	9.0	8.4	4.0	416	31.5	172	112	60	1250	28	85	4,900	900	260
AV			11	9.80	2.44	67.	17.	8.4	5.7	416	31.7	176	118	56	1235	27	87	18,300	3,700	1600
11	07	08 35A	2	11.76	1.97	58.	16.	8.4	0.8			180			1180	24	70	7,000	2,300	2,300
11	08	10 09A	2	12.28	1.82	68.	11.	8.4	1.4			179			1390	22	65	24,000	*200	2,200
11	09	07 40A	2	11.00	2.08	86.	1.	8.4	1.0	353		176			1282	23	70	17,200	3,300	1,100
11	10	08 40A	2	11.26	1.04	79.	5.	8.4	2.2	350		178			1370	22	70	10,900	800	1,700
11	11	07 25A	2	10.54	1.30	45.	9.	8.4	2.2	353		178			1281	23	80	7,900	2,200	3,700
11	12	09 15A	4	11.34	1.51	56.	15.	8.4	3.8	352		178			1250	22	55	2,300	1,300	2,700
11	13	07 55A	2	10.27	1.32	325.	60.	8.3	0	354		179			1390	22	60	79,000	800	210,000
11	14	09 10A	1	12.19	2.15	58.	19.	8.4	2.0	355		176			1281	22	55	4,900	1,300	1,160
11	15	08 00A	2	11.27	1.01	68.	16.	8.3	0	356		174			1266	22	60	4,900	800	1,000
11	16	02 40P	3	13.10	3.00	48.	6.	8.4	4.2	343		177			1750	22	55	13,000	1,400	290,000
11	17	01 40P	3	12.60	2.50	63.	30.	8.4	3.2	353		172			1265	22	60	33,000	17,200	1,800
11	18	08 35A	1	11.77	2.24	87.	24.	8.3	0	352		171			1281	22	75	13,000	1,700	4,200
11	19	04 05A	1	11.13	2.95	161.	34.	8.3	0	357		177			1370	21	120	49,000	4,900	8,000
11	20	04 15A	1		1.78	84.	43.	8.3	0	365		188			1333	19	75	10,900	4,900	2,300
AV			2	11.7	1.9	91.8	20.6	8.3	1.4	354		177			1335	22	69	14,707	3,300	38,001

* Indicates less than

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RESULTS OF ANALYSES

STATION 4 (MP191.6)

Month	Date	Sample Time	Temp. °C	D.O. mg/l	B.O.D. mg/l	Susp. Solids mg/l	Volatile Susp. Solids mg/l	pH	Alkal. Phenol mg/l (as $CaCO_3$)	Alkal. Total mg/l (as $CaCO_3$)	Cl⁻ mg/l	Hard. mg/l	Ca. mg/l	Mg. mg/l	Specf. Conduct. µmhos/cm.	True Color Units	Turb. Units	Coli. M.P.N. Per 100 ml.	Fecal Coli M.P.N. Per 100 ml.	Fecal Strep Per 100 ml.
9	22	09 35A	10	8.60	2.07	120.	6.0	8.2	0	339	27.0	238	156	82	953	26	160			4,700
9	23	09 45A	11	9.23	1.38	34.0	9.0	8.2	0	331	25.8	246	153	93	925	22	55	17,000	5,000	1,210
9	24	09 00A	09	8.88	0.97	88.0	5.0	8.2	0	332	24.7	255	170	85	990	13	50	*2,000	*2,000	640
9	25	11 15A	13	9.69	2.89	46.0	15.0	8.3	0	346	26.8	241	170	71	1052	13	45	4,900	800	230
9	26	01 00P	15	7.93	2.89	184.	17.0	8.2	0	282	13.5	273	122	151	769	17	360	34,800	2,100	800
9	27	12 35P	15	9.48	2.61	61.0	29.0	8.3	0	311	22.9	253	169	84	925	13	45	3,300	500	190
9	28	09 25A	11	9.08	1.60	111.	22.0	8.2	0	253	16.4	265	183	82	820	9	75	5,420	790	150
AV			12	8.98	2.06	92.	14.	8.2	0	313	22.4	253	160	92	919	16	112	11,200	1,900	1,100
11	07	08 50A	4	8.93	23.8	48.	13.	8.0	0			289			710	12	40	49,000	2,000	1,060,000
11	08	09 50A	4	8.92	22.2	56.	17.	8.0	0			290			840	12	35	27,000	4,000	390,000
11	09	07 55A	4	8.29	20.4	154.	17.	8.0	0	204		288			781	13	35	330,000	2,000	700,000
11	10	08 20A	6	7.99	20.9	122.	14.	8.0	0	204		286			861	13	55	172,000	2,000	130,000
11	11	07 45A	6	7.69	22.5	40.	9.	8.0	0	206		287			762	14	40	79,000	*2,000	1,600,000
11	12	08 55A	6	8.27	22.6	58.	18.	8.0	0	200		288			769	12	30	109,000	*2,000	740,000
11	13	08 15A	4	9.03	25.	55.	22.	8.0	0	208		288			870	12	35	63,000	5,000	1,830,000
11	14	08 50A	3	9.15	22.7	84.	20.	8.1	0	187		284			725	9	35	141,000	*2,000	180,000
11	15	08 20A	4	8.44	22.1	62.	25.	7.9	0	203		287			781	11	35	33,000	*2,000	720,000
11	16	02 20P	4	9.36	34.	77.	30.	7.9	0	207		289			800	12	50	33,000	*2,000	290,000
11	17	01 55P	4	8.51	38.1	104.	31.	7.9	0	214		290			832	14	65	130,000	*2,000	290,000
11	18	08 15A	3	8.84	26.3	99.	14.	7.9	0	206		287			819	13	50	79,000	*2,000	630,000
11	19	04 20A	2	8.46	31.1	106.	41.	7.9	0	213		291			854	14	60	12,000	*2,000	420,000
11	20	03 55A	2	8.62	38.6	102.	41.	8.0	0	217		289			813	13	50	130,000	*2,000	870,000
AV			4	8.6	26.5	83.3	22.2	8.0	0	205		288			803	12	44	99,071	2,140	703,571

* Indicates less than

074

NORTH PLATTE RIVER SURVEY
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RESULTS OF ANALYSES

STATION 5 (NP184)

Month	Date	Sample Time	Temp. °C	D.O. mg/l	B.O.D. mg/l	Susp. Solids mg/l	Volatile Susp. Solids mg/l	pH	Alkal. Phenol mg/l (as $CaCO_3$)	Alkal. Total mg/l (as $CaCO_3$)	Cl − mg/l	Hard mg/l	Ca. mg/l	Mg. mg/l	Spect. Conduct. µmhos/cm.	True Color Units	Turb. Units	Coli. M.P.N. Per 100 ml.	Fecal Coli M.P.N Per 100 ml.	Fecal Strep Per 100 ml.
9	22	10 00A	10	8.89	1.69	38.0	14.0	8.1	0	307	22.1	258	158	100	869	12	60			1,360
9	23	09 15A	11	9.37	1.18	19.0	11.0	8.1	0	310	21.7	267	118	149	840	14	25	17,200	4,900	900
9	24	09 25A	10	8.52	1.25	26.0	7.0	8.0	0	292	19.6	280	155	125	847	8	25	13,000	7,900	570
9	25	11 40A	14	10.13	2.43	20.0	9.0	8.2	0	291	21.0	278	192	86	901	9	25	1,300	500	90
9	26	01 20P	15	9.66	3.07	384.	46.	8.4	1.8	254	19.3	283	210	73	820	14	50	1,300	220	160
9	27	01 00P	15	9.53	2.94	41.0	8.0	8.4	2.0	256	19.3	278	193	85	820	12	35	10,900	490	280
9	28	09 50A	12	9.10	1.71	56.0	5.0	8.2	0	257	19.2	277	183	94	827	12	45	3,480	2,400	860
AV			12	9.45	2.04	83.4	7.4	8.2	0	241	20.3	287	172	101	846	11	37	7,900	2,700	740
11	07	09 30A	5	8.90	34.9	45.	17.	8.0	0			291			720	13	30	79,000	11,000	212,000
11	08	09 00A	4	8.83	14.2	50.	23.	8.1	0			293			826	13	30	49,000	*2,000	150,000
11	09	08 40A	5	8.40	16.1	188.	11.	8.0	0	208		290			775	12	30	33,000	1,400	130,000
11	10	07 45A	6	7.98	11.5	172.	20.	8.0	0	207		290			855	12	35	79,000	2,300	470,000
11	11	08 25A	6	7.90	16.8	47.	15.	8.0	0	206		289			769	12	30	79,000	500	220,000
11	12	08 15A	6	8.11	17.	51.	42.	8.0	0	206		289			781	11	25	240,000	2,300	450,000
11	13	08 55A	5	8.69	14.8	225.	20.	8.0	0	206		286			840	13	25	221,000	800	160,000
11	14	08 10A	3	8.87	14.6	57.	22.	8.0	0	206		288			769	8	35	70,000	800	490,000
11	15	09 05A	4	8.60	15.8	62.	32.	7.9	0	202		290			807	12	30	33,000	4,900	128,000
11	16	01 45A	4	9.39	24.4	139.	37.	7.9	0	207		287			819	12	75	79,000	800	200,000
11	17	02 45P	4	8.99	25.8	101.	26.	7.9	0	208		292			781	13	60	109,000	1,300	470,000
11	18	07 35A	3	8.96	20.6	129.	20.	7.9	0	206		287			807	12	40	109,000	800	620,000
11	19	04 50A	3	8.66	22.7	145.	36.	7.9	0	208		289			825	9	70	172,000	2,300	106,000
11	20	03 30A	3	8.68	25.9	98.	28.	8.0	0	208		290			787	14	45	70,000	2,700	90,000
AV			4	8.7	19.65	107.8	26.4	8.0	0	206		289			797	12	40	101,571	2,453	264,000

* Indicates less than

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NORTH PLATTE RIVER SURVEY
WYOMING - NEBRASKA
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RESULTS OF ANALYSES

STATION 6 (MP180.5)

Month	Date	Sample Time	Temp. °C	D.O. mg/l	B.O.D. mg/l	Susp. Solids mg/l	Volatile Susp. Solids mg/l	pH	Alkal. Phenol mg/l (as $CaCO_3$)	Alkal. Total mg/l (as $CaCO_3$)	Cl^- mg/l	Hard. mg/l	Ca. mg/l	Mg. mg/l	Specf. Conduct µmhos/cm.	True Color Units	Turb. Units	Coli. M.P.N. Per 100 ml.	Fecal Coli M.P.N Per 100 ml.	Fecal Strep. Per 100 ml.
9	22	10 45A	10	9.32	1.72	27.0	17.0	8.1	0	289	20.8	277	191	88	813	15	30			1,700
9	23	08 30A	11	8.85	1.47	30.0	10.0	8.1	0	280	19.7	282	201	81	781	12	35	33,000	3,300	1,600
9	24	10 10A	09	8.46	1.08	76.0	8.0	8.1	0	281	19.0	286	203	83	822	9	40	14,000	4,600	1,090
9	25	12 30P	14	9.49	3.33	30.0	8.0	8.1	0	275	20.4	288	200	88	855	9	30	13,000	1,300	190
9	26	01 50P	15	9.18	1.47	60.0	13.0	8.2	0	266	19.4	284	207	77	832	14	40	13,000	700	220
9	27	01 30P	15	9.28	3.26	70.0	9.0	8.3	0	252	18.5	290	176	114	788	9	50	31,000	24,000	520
9	28	10 20A	13	9.04	1.71	50.0	6.0	8.2	0	250	18.0	283	162	121	812	8	45	17,200	4,600	510
AV			12	9.08	2.01	49.	10.	8.1	0	270	19.5	284	191	97	813	10	38	20,200	6,400	800
11	07	10 00A	6	7.80	39.7	64.	26.	8.0	0			310			730	12	60	148,000	5,000	197,000
11	08	08 25A	4	7.75	20.7	82.	31.	8.1	0			302			820	14	50	330,000	5,000	240,000
11	09	09 30A	6	7.38	20.	162.	30.	8.0	0	216		302			787	13	50	221,000	5,000	137,000
11	10	07 15A	6	6.73	21.4	226.	22.	8.0	0	217		304			848	13	60	130,000	8,000	170,000
11	11	09 05A	7	6.94	22.	115.	33.	8.0	0	216		302			781	13	60	490,000	2,000	250,000
11	12	07 35A	6	6.80	23.2	230.	36.	8.0	0	215		305			787	14	85	240,000	130,000	530,000
11	13	09 35A	6	7.72	30.6	92.	34.	8.0	0	210		298			848	13	50	130,000	8,000	210,000
11	14	07 30A	4	7.66	19.6	110.	32.	8.0	0	210		300			769	9	65	79,000	2,000	40,000
11	15	09 40A	4	7.53	24.2	142.	28.	8.0	0	218		309			826	14	70	79,000	2,000	350,000
11	16	01 10P	4	8.38	30.9	137.	32.	7.8	0	216		296			752	12	70	172,000	2,000	300,000
11	17	03 40P	4	8.03	28.	162.	42.	7.8	0	220		299			775	13	95	109,000	23,000	490,000
11	18	07 05A	4	7.77	26.4	209.	42.	7.9	0	218		302			819	12	80	490,000	4,000	840,000
11	19	05 15A	3	7.56	22.8	135.	56.	7.8	0	218		300			819	12	85	79,000	2,000	460,000
11	20	03 00A	3	7.43	29.1	197.	65.	8.0	0	216		304			793	12	85	109,000	92,000	360,000
AV			4	7.5	25.6	147.3	36.3	7.9	0	215		302			797	13	69	200,428	15,230	301,000

* Indicates less than

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NORTH PLATTE RIVER SURVEY
WYOMING - NEBRASKA
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RESULTS OF ANALYSES
STATION 7 (MP177.3)

Month	Date	Sample Time	Temp. °C	D.O. mg/l	B.O.D. mg/l	Susp. Solids mg/l	Volatile Susp. Solids mg/l	pH	Alkal. Phenol mg/l (as CaCO3)	Alkal. Total mg/l (as CaCO3)	Cl − mg/l	Hard. mg/l	Ca. mg/l	Mg. mg/l	Specf. Conduct µmhos/cm.	True Color Units	Turb. Units	Coli. M.P.N Per 100 ml.	Fecal Coli MPN Per 100 ml.	Fecal Strep. Per 100 ml.
9	22	12 05P	10	9.68	1.65	19.0	2.0	8.1	0	280	21.4	298	206	92	800	15	*25			1,900
9	23	07 30A	10	8.97	1.67	52.0	21.0	8.1	0	281	21.0	298	198	100	812	13	45	24,000	2,300	3,600
9	24	11 00A	10	9.06	1.60	116.	15.0	8.0	0	270	20.6	298	202	96	832	10	75	4,900	1,300	800
9	25	01 00P	14	9.41	3.48	34.0	5.0	8.2	0	273	21.8	297	204	93	847	10	30	6,300	1,100	170
9	26	02 15P	15	9.12	2.78	43.0	12.0	8.2	0	274	21.7	294	210	84	855	14	35	3,300	*200	90
9	27	01 55P	15	9.33	2.31	53.0	11.0	8.3	0	251	18.4	289	153	136	781	10	50	23,000	800	400
9	28	10 40A	13	9.34	2.06	51.0	2.0	8.3	0	250	18.1	286	192	94	812	12	50	2,300	1,300	22
AV			12	9.27	2.22	53.	9.	8.1	0	268	18.	294	195	99	819	12	*44	10,600	1,300	1,000
11	07	10 25A	6	7.86	21.0	88.	25.	8.0	0			316			740	12	55	172,000	11,000	288,000
11	08	07 36A	4	7.23	15.6	88.	34.	8.0	0			306			827	12	50	221,000	4,000	160,000
11	09	10 00A	6	7.27	22.4	115.	19.	8.0	0	218		309			787	13	55	120,000	2,000	126,000
11	10	06 45A	5	6.46	18.8	242.	40.	8.0	0	220		311			848	14	70	172,000	5,000	110,000
11	11	09 40A	7	7.06	15.	124.	29.	8.0	0	216		306			794	11	60	330,000	5,000	122,000
11	12	07 00A	6	6.90	14.5	115.	32.	8.0	0	215		304			775	12	55	109,000	5,000	350,000
11	13	10 10A	6	7.49	27.	130.	43.	7.9	0	215		304			848	12	50	172,000	2,000	160,000
11	14	06 55A	4	7.39	14.4	115.	28.	8.0	0	214		304			769	13	75	79,000	7,000	400,000
11	15	10 15A	4	7.77	15.4	110.	27.	8.0	0	216		304			775	9	55	278,000	8,000	240,000
11	16	12 30P	4	8.01	30.8	194.	42.	7.8	0	219		299			752	12	95	34,000	2,000	470,000
11	17	04 15P	4	7.94	19.6	185.	45.	7.9	0	220		304			775	13	95	141,000	13,000	340,000
11	18	06 30A	3	7.82	18.2	209.	48.	7.9	0	216		304			812	13	80	172,000	2,000	430,000
11	19	05 45A	3	7.55	21.8	210.	43.	7.9	0	220		305			832	13	110	79,000	8,000	370,000
11	20	02 35A	3	6.98	22.6	282.	58.	8.0	0	216		306			793	14	85	221,000	2,000	350,000
AV			4	7.4	19.79	157.6	36.6	7.9	0	217		305			795	12	70	186,143	5,429	279,714

* Indicates less than

NORTH PLATTE RIVER SURVEY
WYOMING - NEBRASKA
SEPTEMBER & NOVEMBER 1961
RESULTS OF ANALYSES
STATION 8 (MP173.8)

Month	Date	Sample Time	Temp. °C	D.O. mg/l	B.O.D. mg/l	Susp. Solids mg/l	Volatile Susp. Solids mg/l	pH	Alkal. Phenol mg/l (as $CaCO_3$)	Alkal. Total mg/l (as $CaCO_3$)	Cl − mg/l	Hard. mg/l	Ca. mg/l	Mg. mg/l	Spect. Conduct. µmhos/cm.	True Color Units	Turb. Units	Coli. M.P.N. Per 100 ml.	Fecal Coli M.P.N. Per 100 ml.	Fecal Strep. Per 100 ml.
9	22	12 35P	10	9.64	1.71	44.0	3.0	8.1	0	282	21.9	300	204	96	820	14	30			1,800
9	23	07 10A	10	9.09	1.75	63.0	16.0	8.1	0	283	20.9	295	160	135	800	13	55	21,000	3,300	3,500
9	24	11 50A	10	9.29	2.72	246.	32.0	8.2	0	266	20.0	297	155	142	827	13	170	34,800	4,900	2,600
9	25	08 40A	09	9.64	2.05	64.0	11.0	8.2	0	259	20.4	298	204	94	813	9	60	13,000	3,300	780
9	26	10 40A	12	9.50	2.13	39.0	10.0	8.2	0	266	20.0	296	199	97	832	12	40	14,100	1,700	210
9	27	10 30A	12	9.57	2.90	53.0	15.0	8.3	0	263	19.4	290	200	90	827	10	50	7,000	800	360
9	28	07 30A	10	8.98	1.81	73.0	3.0	8.3	0	253	18.6	291	184	107	813	13	75	22,100	3,300	560
AV			10	9.35	2.15	83.	12.	8.2	0	269	20.1	295	186	123	818	12	68	19,000	2,900	1,400
11	07	11 00A	6	7.48	19.0	90.	32.	7.9	0			313			770	12	50	172,000	23,000	135,000
11	08	07 10A	4	7.14	13.2	94.	32.	8.0	0			310			827	13	60	221,000	13,000	163,000
11	09	10 20A	6	7.14	15.6	230.	22.	8.0	0	221		309			787	12	65	130,000	*2,000	69,000
11	10	06 30A	5	6.34	10.4	203.	17.	8.0	0	220		308			848	12	55	130,000	8,000	160,000
11	11	10 00A	8	6.66	12.7	111.	30.	8.0	0	219		308			806	13	50	109,000	2,000	170,000
11	12	06 40A	6	6.50	12.9	119.	43.	8.0	0	220		308			794	12	50	130,000	*2,000	270,000
11	13	10 40A	6	7.51	21.9	92.	9.	8.0	0	217		308			848	12	40	130,000	4,000	380,000
11	14	06 30A	4	7.13	11.8	111.	23.	8.0	0	217		306			769	12	60	109,000	*2,000	340,000
11	15	10 40A	4	7.40	13.8	98.	27.	8.0	0	220		308			787	13	55	79,000	8,000	260,000
11	16	12 15P	4	7.92	21.5	122.	31.	7.9	0	221		308			826	13	85	49,000	*2,000	330,000
11	17	04 35P	4	7.56	16.7	168.	42.	7.9	0	221		305			775	14	90	130,000	*2,000	370,000
11	18	05 45A	3	7.40	15.8	165.	36.	7.9	0	218		306			812	12	70	141,000	5,000	520,000
11	19	06 00A	3	7.29	15.	179.	51.	7.9	0	218		305			825	12	110	330,000	5,000	370,000
11	20	02 20A	2	7.37	14.6	161.	47.	8.0	0	218		308			807	13	85	130,000	5,000	360,000
AV			4	7.2	15.35	138.7	31.5	7.9	0	217		307			806	12	66	142,142	8,111	278,357

* Indicates less than

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NORTH PLATTE RIVER SURVEY
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RESULTS OF ANALYSES

STATION 9 (NP166)

Month	Date	Sample Time	Temp. °C	D.O. mg/l	B.O.D. mg/l	Susp. Solids mg/l	Volatile Susp. Solids mg/l	pH	Alkal. Phenol mg/l (as $CaCO_3$)	Alkal. Total mg/l (as $CaCO_3$)	Cl⁻ mg/l	Hard. mg/l	Ca. mg/l	Mg. mg/l	Spec. Conduct. µmhos/cm.	True Color Units	Turb. Units	Coli. M.P.N. Per 100 ml.	Fecal Coli M.P.N. Per 100 ml.	Fecal Strep. Per 100 ml.
9	21	10 05A	15	8.46	4.88	74.0	23.0	8.1	0	292	26.0	291	203	88	870	12	40			500
9	22	07 10A	11	7.47	3.87	136.	9.0	8.0	0	278	23.7	288	188	100	789	14	90	490,000	109,000	18,000
9	23	11 40A	14	8.10	4.76	237.	33.0	8.1	0	288	22.9	297	108	189	813	14	120	79,000	17,000	1,700
9	24	07 15A	11	8.02	4.50	195.	25.0	8.1	0	282	21.4	295	128	167	840	11	120	34,800	22,000	5,100
9	25	07 10A	09	8.66	3.89	1165.	57.0	8.2	0	266	22.2	314	182	132	813	11	180	79,000	33,000	3,300
9	26	03 15P	16	7.70	**7.35	458.	36.0	8.2	0	272	22.1	300	219	81	847	14	100	33,000	17,000	7,700
9	27	02 40P	16	7.97	4.87	338.	24.0	8.2	0	269	21.2	294	188	106	827	13	90	70,000	33,000	2,800
AV			13	8.07	**4.87	371.9	29.	8.1	0	278	22.6	297	175	127	828	12	105	183,000	38,500	5,600
11	07	11 35A	8	5.04	35.	211.	33.	8.0	0			324			780	13	95	110,000	40,000	710,000
11	08	06 00A	5	4.39	25.	302.	43.	8.0	0			320			847	12	110	490,000	46,000	1,100,000
11	09	11 00A	8	4.79	29.8	407.	41.	7.9	0	242		318			827	14	95	1,300,000	70,000	1,200,000
11	10	08 05A	6	3.76	27.4	409.	73.	7.9	0	239		320			885	14	95	700,000	34,000	4,900,000
11	11	07 25A	6	3.11	33.8	406.	59.	7.9	0	240		318			806	16	130	700,000	49,000	890,000
11	12	08 00A	7	4.08	38.3	449.	68.	7.9	0	240		322			832	16	110	330,000	*20,000	2,000,000
11	13	12 05P	8	4.61	34.2	333.	60.	7.9	0	234		320			869	14	100	170,000	*20,000	690,000
11	14	07 20A	4	4.21	27.6	421.	67.	8.0	0	236		316			781	13	150	330,000	8,000	1,300,000
11	15	11 20A	5	5.00	28.	385.	49.	7.9	0	240		316			820	16	130	490,000	13,000	1,050,000
11	16	03 45P	4	4.70	45.5	357.	58.	7.8	0	237		315			813	22	140	460,000	109,000	1,200,000
11	17	12 00A	4	4.50	35.9	367.	64.	7.8	0	243		316			805	16	140	1,300,000	5,000	610,000
11	18	07 45A	3	4.98	35.4	502.	68.	7.9	0	240		320			832	13	150	240,000	32,000	2,100,000
11	19	07 00A	4	4.89	37.	548.	108.	7.8	0	234		312			832	16	140	330,000	13,000	2,000,000
11	20	01 35A	4	4.20	41.6	581.	103.	7.9	0	238		321			825	14	140	1,300,000	49,000	3,000,000
AV			5	4.45	33.9	405.5	63.8	7.9	0	238		318			825	15	123	589,256	39,000	1,625,000

* Indicates less than

** Indicates more than

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NORTH PLATTE RIVER SURVEY
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RESULTS OF ANALYSES

STATION 10 (NP160.2)

Month	Date	Sample Time	Temp. °C	D.O. mg/l	B.O.D. mg/l	Susp. Solids mg/l	Volatile Susp. Solids mg/l	pH	Alkal. Phenol mg/l (as $CaCO_3$)	Alkal. Total mg/l (as $CaCO_3$)	Cl^- mg/l	Hard. mg/l	Ca. mg/l	Mg. mg/l	Specf. Conduct. µmhos/cm.	True Color Units	Turb Units	Coli. M.P.N. Per 100 ml.	Fecal Coli M.P.N. Per 100 ml.	Fecal Strep. Per 100 ml.
9	21	10 25A	15	7.54	5.19	75.0	19.0	8.0	0	294	26.8	310	213	97	870	13	45			810
9	22	07 45A	11	7.54	4.68	130.	15.0	8.0	0	272	25.4	282	196	86	775	12	90	1,090,000	70,000	22,000
9	23	11 15A	14	8.10	4.21	184.	33.0	8.1	0	288	24.5	298	207	91	827	14	75	90,000	40,000	4,200
9	24	07 40A	11	8.09	5.50	276.	16.0	8.1	0	287	22.3	298	207	91	870	11	120	230,000	50,000	7,000
9	25	07 30A	09	8.69	4.74	1293.	64.0	8.2	0	279	19.8	310	211	99	840	11	210	240,000	33,000	5,500
9	26	03 00P	16	7.90	5.87	789.	49.0	8.2	0	276	22.3	305	206	99	855	15	150	33,000	17,000	500
9	27	02 20P	16	8.28	3.00	510.	54.0	8.2	0	274	21.5	298	205	93	840	9	120	109,000	11,000	600
AV			13	8.02	4.74	465.	35.	8.1	0	281	23.2	300	207	93	841	12	115	499,000	37,000	5,800
11	07	11 50A	7	5.78	28.5	228.	48.	8.0	0			332			800	14	75	230,000	*20,000	750,000
11	08	06 25A	4	5.17	20.8	354.	54.	7.9	0			320			862	12	90	490,000	49,000	390,000
11	09	10 35A	7	5.10	19.6	366.	58.	7.9	0	246		322			832	13	95	240,000	23,000	1,040,000
11	10	08 35A	6	2.38	24.6	432.	77.	7.9	0	248		319			885	13	110	790,000	94,000	2,000,000
11	11	07 50A	6	2.37	32.4	490.	74.	7.9	0	245		324			813	14	170	700,000	11,000	1,880,000
11	12	08 25A	6	3.33	30.1	390.	62.	7.9	0	246		322			794	13	120	790,000	13,000	1,200,000
11	13	11 45A	7	4.51	26.2	360.	52.	7.9	0	240		320			892	18	120	330,000	2,000	510,000
11	14	07 45A	4	3.69	26.9	446.	66.	8.0	0	242		318			806	16	140	460,000	21,000	1,800,000
11	15	11 00A	4	4.50	24.8	398.	49.	7.9	0	242		320			826	17	140	172,000	23,000	700,000
11	16	03 20P	4	5.13	31.6	365.	61.	7.8	0	251		316			800	14	140	490,000	5,000	730,000
11	17	12 20P	4	4.71	31.9	425.	70.	7.8	0	247		318			813	17	160	790,000	14,000	750,000
11	18	08 15A	4	4.54	36.8	492.	86.	7.9	0	246		319			812	13	140	9,200,000	23,000	1,400,000
11	19	06 40A	3	4.42	29.9	522.	99.	7.8	0	241		319			870	17	150	490,000	49,000	2,000,000
11	20	01 55A	4	4.09	27.8	533.	96.	7.9	0	240		322			819	13	160	490,000	33,000	1,500,000
AV			4	4.27	27.99	414.3	68.	7.9	0	244		320			830	14	129	1,118,713	27,692	1,189,285

* Indicates less than

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NORTH PLATTE RIVER SURVEY
WYOMING - NEBRASKA
SEPTEMBER & NOVEMBER 1961
RESULTS OF ANALYSES

STATION 11 (MP154.6)

Month	Date	Sample Time	Temp. °C	D.O. mg/l	B.O.D. mg/l	Susp. Solids mg/l	Volatile Susp. Solids mg/l	pH	Alkal. Phenol mg/l (as $CaCO_3$)	Alkal. Total mg/l (as $CaCO_3$)	Cl⁻ mg/l	Hard. mg/l	Ca. mg/l	Mg. mg/l	Spect. Conduct µmhos/cm.	True Color Units	Turb. Units	Coli. M.P.N. Per 100 ml.	Fecal Coli M.P.N. Per 100 ml.	Fecal Strep. Per 100 ml.
9	21	10 45A	16	8.79	4.65	120.	32.0	8.1	0	284	27.0	314	211	103	870	12	55			830
9	22	08 05A	11	8.12	5.02	125.	16.0	8.0	0	270	26.8	298	200	98	800	13	90	330,000	33,000	22,000
9	23	10 55A	13	8.50	3.35	337.	41.0	8.2	0	265	22.0	306	206	100	770	14	130	172,000	109,000	7,000
9	24	11 00A	10	8.89	4.72	467.	44.0	8.1	0	255	19.9	298	200	98	775	12	130	70,000	49,000	4,100
9	25	08 00A	10	9.21	5.14	707.	66.0	8.2	0	282	22.4	310	184	126	855	10	200	172,000	70,000	2,700
9	26	02 45P	16	8.14	6.66	499.	43.0	8.1	0	271	22.7	308	178	130	855	16	150	63,000	23,000	800
9	27	01 50P	16	8.30	2.90	357.	24.0	8.3	0	263	20.5	302	178	124	827	8	100	172,000	17,000	1,400
AV			13	8.56	4.63	3.	37.	8.1	0	270	23.0	305	193	111	821	12	122	163,000	50,000	5,300
11	07	12 05P	6	5.62	17.0	186.	37.	8.0	0			332			814	12	70	230,000	*20,000	300,000
11	08	06 45A	4	5.48	16.4	347.	66.	7.9	0			319			832	13	80	790,000	33,000	490,000
11	09	10 10A	6	5.25	19.2	405.	59.	7.9	0	242		326			827	13	100	790,000	49,000	280,000
11	10	08 55A	6	4.62	19.	387.	44.	7.9	0	238		324			867	13	95	221,000	109,000	780,000
11	11	11 15A	8	4.55	24.1	492.	76.	7.9	0	245		322			826	14	150	221,000	170,000	640,000
11	12	08 45A	6	5.19	22.	414.	52.	7.9	0	246		322			800	9	100	278,000	13,000	800,000
11	13	10 15A	6	5.33	20.8	351.	53.	7.9	0	242		320			900	12	120	278,000	17,000	340,000
11	14	08 05A	4	5.69	20.8	317.	55.	8.0	0	237		318			806	13	110	330,000	49,000	620,000
11	15	10 40A	4	8.04	19.4	357.	54.	7.9	0	242		319			822	14	130	490,000	13,000	530,000
11	16	01 55P	4	6.01	24.8	323.	49.	7.8	0	246		319			813	12	120	172,000	33,000	470,000
11	17	12 45P	4	5.42	28.2	414.	81.	7.9	0	253		320			805	17	170	330,000	23,000	860,000
11	18	08 40A	2	6.38	26.3	417.	80.	7.9	0	242		320			825	13	150	490,000	79,000	790,000
11	19	04 55A	3	5.06	24.2	493.	84.	7.8	0	243		320			854	14	150	240,000	13,000	810,000
11	20	05 00A	2	6.06	23.6	672.	117.	7.9	0	250		321			832	14	160	330,000	23,000	390,000
AV			4	5.69	21.84	398.3	64.7	7.9	0	243		321			830	13	121	370,714	480,000	578,571

* Indicates less than

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NORTH PLATTE RIVER SURVEY
WYOMING - NEBRASKA
SEPTEMBER & NOVEMBER 1961
RESULTS OF ANALYSES

STATION 12 (NP149.8)

Month	Date	Sample Time	Temp. °C	D.O. mg/l	B.O.D. mg/l	Susp. Solids mg/l	Volatile Susp. Solids mg/l	pH	Alkal. Phenol mg/l (as $CaCO_3$)	Alkal. Total mg/l (as $CaCO_3$)	Cl⁻ mg/l	Hard mg/l	Ca. mg/l	Mg. mg/l	Spec. Conduct µmhos/cm.	True Color Units	Turb. Units	Coli. M.P.N. Per 100 ml.	Fecal Coli M.P.N. Per 100 ml.	Fecal Strep Per 100 ml.
9	21	11 40A	17	8.41	4.78	121.	19.0	8.1	0	262	26.0	315	201	114	870	11	60			350
9	22	08 30A	11	8.47	3.35	174.	28.0	8.1	0	256	24.5	294	184	110	770	14	110	46,000	5,000	6,100
9	23	07 15A	10	9.20	3.05	278.	39.0	8.2	0	271	24.8	306	76	230	910	21	120	109,000	22,000	4,900
9	24	08 15A	11	8.83	3.80	189.	25.0	8.2	0	289	26.8	310	216	94	910	15	140	33,000	8,000	1,400
9	25	08 30A	09	9.69	4.30	266.	22.0	8.3	0	287	25.5	310	108	202	800	14	140	33,000	8,000	3,400
9	26	12 15P	14	8.47	**7.50	824.	58.0	8.2	0	287	25.7	314	178	136	925	21	200	70,000	13,000	1,000
9	27	11 00A	14	8.40	3.88	181.	25.0	8.3	0	281	26.9	310	206	104	910	13	120	79,000	3,300	1,600
AV			12	8.78	**4.38	290.	30.0	8.2	0	276	25.9	308	167	142	870	15	129	62,000	14,800	2,700
11	07	01 35P	7	6.68	22.	253.	49.	7.9	0			337			812	12	90	175,000	23,000	120,000
11	08	08 40A	4	7.46	15.	336.	79.	7.9	0			325			862	13	90	490,000	33,000	260,000
11	09	08 20A	5	7.02	13.9	333.	46.	7.9	0	242		325			840	14	90	221,000	79,000	410,000
11	10	10 45A	7	6.50	18.4	357.	50.	8.0	0	240		324			901	14	100	221,000	13,000	280,000
11	11	09 45A	7	5.89	19.4	364.	50.	7.9	0	242		326			832	14	120	172,000	33,000	270,000
11	12	10 20A	6	6.98	15.	350.	47.	8.0	0	238		323			812	14	120	278,000	17,000	750,000
11	13	09 50A	5	7.00	16.	47.	21.	7.9	0	242		324			910	11	110	130,000	8,000	320,000
11	14	09 35A	4	6.99	16.8	400.	66.	8.0	0	240		320			813	12	120	490,000	17,000	550,000
11	15	09 05A	4	7.39	15.8	357.	60.	7.9	0	240		323			832	13	130	221,000	13,000	320,000
11	16	01 30P	4	8.14	18.4	291.	55.	7.9	0	236		320			813	13	130	330,000	17,000	250,000
11	17	02 15P	4	6.90	22.	433.	69.	7.9	0	248		322			805	14	160	330,000	23,000	300,000
11	18	10 25A	2	7.55	26.8	458.	76.	7.9	0	240		322			825	13	150	1,300,000	13,000	480,000
11	19	04 35A	2	7.23	18.3	357.	78.	7.9	0	238		320			848	12	140	330,000	17,000	660,000
11	20	04 30A	2	7.27	24.3	1085.	153.	8.0	0	248		323			840	13	210	1,090,000	17,000	690,000
AV			4	7.07	19.44	387.2	64.2	7.9	0	241		323			839	13	125	412,714	23,071	405,714

** Indicates more than

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NORTH PLATTE RIVER SURVEY
WYOMING - NEBRASKA
SEPTEMBER & NOVEMBER 1961
RESULTS OF ANALYSES
STATION 13 (RW1A9.3-0.5)

Month	Date	Sample Time	Temp. °C	D.O. mg/l	B.O.D. mg/l	Susp. Solids mg/l	Volatile Susp. Solids mg/l	pH	Alkal. Phenol mg/l (as $CaCO_3$)	Alkal. Total mg/l (as $CaCO_3$)	Cl⁻ mg/l	Hard. mg/l	Ca. mg/l	Mg. mg/l	Specf. Conduct. µmhos/cm.	True Color Units	Turb. Units	Coli. M.P.N. Per 100 ml.	Fecal Coli M.P.N Per 100 ml.	Fecal Strep. Per 100 ml.
9	21	04 15P	14	7.91																4,500
9	22	10 30A	11	9.19														46,000	21,000	1,300
9	23	10 15A	11	8.77														70,000	14,000	40,000
9	24	10 25A	10	8.91														33,000	13,000	4,500
9	25	10 30A	13	9.23														34,800	10,900	1,100
9	26	02 20P	17	8.41														34,800	13,000	2,300
9	27	01 20P	13	8.74														14,100	3,100	500
AV			12	8.75					0									38,800	12,500	6,100
11	07	01 00P	10	10.60	2.88	43.	10.	8.1	0		321				740	7	*25	7,900	1,700	600
11	08	07 55A	5	9.90	0.74	18.4	6.	8.0	0		316				770	7	*25	7,900	2,400	2,500
11	09	09 10A	6	10.10	1.19	14.4	4.	8.1	0	192	318				757	8	*25	4,900	3,300	440
11	10	09 55A	8	10.26	1.32	14.8	5.6	8.1	0	192	318				775	7	*25	7,000	410	530
11	11	10 25A	8	10.21	1.12	22.8	9.6	8.1	0	193	317				735	7	*25	13,000	500	600
11	12	09 35A	8	9.92	1.11	16.4	6.	8.1	0	193	317				752	13	*25	4,300	1,300	1,100
11	13	11 10A	8	10.97	0.98	12.	6.4	8.0	0	192	316				806	7	*25	10,900	200	160,000
11	14	08 55A	4	10.27	0.97	32.4	6.4	8.1	0	191	316				725	7	*25	3,300	2,300	900
11	15	09 50A	6	10.18	1.08	17.	8.	8.0	0	192	315				719	7	*25	17,200	4,900	960
11	16	02 40P	6	11.56	3.49	132.	13.5	8.1	0	190	311				709	6	*25	10,900	7,000	730
11	17	01 35P	6	11.27	1.27	19.	17.	8.0	0	192	316				714	6	*25	33,000	10,900	660
11	18	09 40A	5	10.50	1.41	18.	3.3	8.1	0	191	314				724	6	*25	13,000	1,300	650
11	19	05 30A	4	9.40	2.05	142.	22.5	8.0	0	192	316				781	8	*25	79,000	49,000	6,000
11	20	02 45A	4	9.62	1.52	28.5	16.	8.0	0	176	309				704	7	*25	7,900	2,300	930
AV			6	10.34	1.51	37.9	10.9	8.0	0	190	315				744	7	*25	15,729	6,251	12,614

* Indicates less than

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NORTH PLATTE RIVER SURVEY
WYOMING - NEBRASKA
SEPTEMBER & NOVEMBER 1961
RESULTS OF ANALYSES
STATION 14 (MP141.8)

Month	Date	Sample Time	Temp °C	D.O. mg/l	B.O.D. mg/l	Susp. Solids mg/l	Volatile Susp. Solids mg/l	pH	Alkal. Phenol mg/l (as $CaCO_3$)	Alkal. Total mg/l (as $CaCO_3$)	Cl^- mg/l	Hard. mg/l	Ca mg/l	Mg mg/l	Specf. Conduct µmhos/cm.	True Color Units	Turb. Units	Coli. M.P.N. Per 100 ml.	Fecal Coli M.P.N Per 100 ml.	Fecal Strep Per 100 ml.
9	21	12 20P	16	8.60	4.50	140.	22.4	8.1	0	278	24.5	318	112	106	832	9	85			360
9	22	09 15A	11	8.90	3.07	122.	5.0	8.2	0	262	23.5	306	171	135	763	13	120	49,000	3,300	4,600
9	23	07 45A	10	9.03	3.15	226.	39.0	8.2	0	269	23.1	302	88	214	776	15	150	21,000	13,000	5,300
9	24	08 45A	10	8.85	3.82	162.	25.0	8.1	0	267	23.3	306	72	234	848	14	140	33,000	23,000	5,700
9	25	08 50A	10	9.56	2.87	792.	42.0	8.3	0	264	21.4	310	196	114	819	10	160	46,000	*2,000	1,800
9	26	12 50P	16	9.00	3.44	1036.	68.0	8.3	0	264	22.3	310	146	164	855	14	210	49,000	7,000	1,100
9	27	11 40A	14	9.09	3.07	234.	25.0	8.3	0	268	21.7	312	167	145	848	14	120	34,800	4,900	2,100
AV			12	9.00	3.42	387.	32.3	8.1	0	268	22.0	309	136	158	819	12	126	38,800	8,900	3,000
11	07	02 05P	7	8.34	17.	245.	42.	8.0	0			338			820	13	80	240,000	49,000	118,000
11	08	09 15A	4	8.73	16.	349.	54.	8.0	0			322			848	12	100	1,300,000	13,000	220,000
11	09	07 45A	4	8.05	17.	396.	39.	8.0	0	240		320			827	13	95	221,000	13,000	130,000
11	10	11 20A	7	8.10	14.4	391.	62.	8.0	0	236		326			870	14	100	221,000	17,000	14,000
11	11	09 15A	6	7.60	15.7	410.	45.	8.0	0	237		321			800	13	90	79,000	23,000	230,000
11	12	10 50A	6	8.41	14.6	631.	161.	8.0	0	236		322			812	7	120	109,000	13,000	540,000
11	13	08 30A	4	8.88	14.4	401.	46.	8.0	0	235		315			876	13	110	79,000	5,000	570,000
11	14	10 05A	4	9.05	14.4	321.	54.	8.0	0	232		324			806	12	110	221,000	5,000	300,000
11	15	08 30A	3	8.87	15.8	450.	84.	8.0	0	239		317			814	13	130	221,000	49,000	150,000
11	16	12 55P	2	9.56	17.2	416.	53.	7.9	0	242		324			807	13	120	490,000	8,000	400,000
11	17	02 50P	3	8.90	19.2	481.	85.	7.9	0	246		320			884	14	140	172,000	8,000	390,000
11	18	11 05A	2	9.26	24.4	366.	57.	7.9	0	235		324			825	12	130	430,000	17,000	230,000
11	19	03 20A	2	9.28	17.2	457.	83.	7.9	0	236		320			840	12	130	330,000	2,000	220,000
11	20	03 20A	1	8.70	22.4	369.	108.	8.0	0	240		320			832	13	160	172,000	5,000	410,000
AV			3	8.62	17.1	405.9	69.5	7.9	0	237		322			833	12	115	306,071	16,214	280,143

* Indicates less than

NORTH PLATTE RIVER SURVEY
WYOMING - NEBRASKA
SEPTEMBER & NOVEMBER 1961
RESULTS OF ANALYSES

STATION 15 (RP127)

Month	Date	Sample Time	Temp. °C	D.O. mg/l	B.O.D. mg/l	Susp. Solids mg/l	Volatile Susp. Solids mg/l	pH	Alkal. Phenol mg/l (as CaCO3)	Alkal. Total mg/l (as CaCO3)	Cl⁻ mg/l	Hard. mg/l	Ca. mg/l	Mg. mg/l	Spect. Conduct. µmhos/cm.	True Color Units	Turb. Units	Coli. M.P.N. Per 100 ml.	Fecal Coli M.P.N Per 100 ml	Fecal Strep Per 100 ml.
9	21	12 50P	17	8.61	4.19	165.	28.0	8.2	0	272	23.7	304	194	110	770	10	100			
9	22		1	9 2	4.10	272.	36.0	8.2	0	254	20.9	283	193	90	709	12	150			220
9	23	08 30A	10	9.19	3.20	186.	30.0	8.2	0	257	22.2	286	188	98	750	15	160	33,000	23,000	3,700
9	24	09 1 A		9.2	3 61	256.	10.0	8.2	0	270	22.1	302	116	186	800	14	180	34,80	7,900	3,300
9	25	09 35A	10	9.92	2.79	413.	7.0	8.3	0	271	21.2	306	216	90	794	14	160	21,000	4,900	1,900
9	26	0 0P	16	9.35	4.13	283.	37 0	8 3	0	266	21.0	305	132	173	840	14	180	17,200	4,900	600
9	27	2 00P	15	9.13	3.19	256.	27.0	8.4	2.2	261	20.4	302	130	172	820	14	150	54,200	7,000	900
AV			12	9.22	3.6	262.	25.	8.2	0	264	2 2	298	167	131	783	13	154	32,000	1,700	9,500
11	07	02 30P	6	10.33	11.5	196.	31.	8.1	0			324			794	13	75	34,000	5,000	57,000
11	08	09 55A	4	10.45	9.50	298.	29	8.0	0			314			827	9	85	130,000	7,900	46,000
11	09	07 10A	4	9.81	11.6	291.	40.	8.1	0	234		312			793	8	75	172,000	10,900	43,000
11	10	11 45A	7	9.90	10.	350.	51.	8.1	0	230		318			855	12	95	109,000	3,300	22,000
11	11	08 35A	5	9.43	10.8	336.	45.	8.1	0	232		318			769	12	80	79,000	4,000	51,000
11	12	11 15A	6	9.87	10.8	275.	43.	8.1	0	232		310			775	12	110	79,000	2,000	59,000
11	13	09 00A	3	10.60	9.29	279.	45.	8.1	0	231		313			840	12	85	109,000	2,000	28,000
11	14	10 35A	3	11.00	8.60	342.	48.	8.1	0	230		312			707	9	100	49,000	2,000	69,000
11	15	07 55A	2	10.55	10.1	323.	49.	8.1	0	231		309			769	12	110	70,000	5,000	75,000
11	16	12 25P	2	11.38	11.1	285.	51.	8.0	0	232		311			7 2	8	120	490,000	8,000	87,000
11	17	03 15P	2	10.90	11.2	300.	56.	8.1	0	227		310			764	9	120	172,000	2,000	63,000
11	18	11 40A	2	11.21	17.2	375.	53.	8.0	0	226		308			762	9	120	79,000	2,000	107,000
11	19	03 00A	1	10.99	11.6	275.	50.	8.0	0	228		308			800	12	110	109,000	5,000	81,000
11	20	03 45A	1	10.45	12.6	332.	93.	8.1	0	230		311			793	11	130	330,000	7,000	101,000
AV			3	10.49	11.14	304.0	48.8	8.0	0	230		312			786	10	101	143,643	4,721	63,643

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STATION 16 (GG173-1.5)

Month	Date	Sample Time	Temp. °C	D.O. mg/l	B.O.D. mg/l	Susp. Solids mg/l	Volatile Susp. Solids mg/l	pH	Alkal. Phenol mg/l (as $CaCO_3$)	Alkal. Total mg/l (as $CaCO_3$)	Cl⁻ mg/l	Hard. mg/l	Ca. mg/l	Mg. mg/l	Specf. Conduct µmhos/cm.	True Color Units	Turb. Units	Coli. M.P.N Per 100 ml.	Fecal Coli M.P.N Per 100 ml.	Fecal Strep. Per 100 ml.
9	22	03 00P	17	5.10	17.4	27.0	9.0	8.0	0	337	48.6	278	175	103	943	22	50	230,000	49,000	51,000
9	23	01 30P	16	6.12	5.17	25.0	22.0	7.9	0	393	37.4	350	240	110	990	19	*25	79,000	33,000	29,000
9	24	11 25A	13	6.10	17.4	39.0	27.0	8.1	0	382	38.1	339	233	106	1020	36	70	348,000	348,000	206,000
9	25	08 30A	13	7.66	1.82	4.0	4.0	8.1	0	371	41.4	338	229	109	1030	8	*25	348,000	348,000	6,200
AV			15	6.24	10.4	23.8	15.	8.	0	378	41.3	326	219	107	990	23	*23	251,000	194,300	73,000
11	07	11 10A	36															1,720,000	230,000	12,000,000
11	08	05 30A	38		201.	4225.	348.	7.7		266		312			762	44	800	2,400,000	140,000	17,700,000
11	09	11 25A	36		324.	2224.	236.	7.6		208		305			832	46	900	4,900,000	1,300,000	186,000,000
11	10	07 40A	35		197.	2636.	340.	7.6		209		314			825	50	1000	34,800,000	170,000	35,000,000
11	11	11 50A	35		392.	3348.	400.	7.5		212		307			757	55	1200	14,000,000	80,000	91,000,000
11	12	07 30A	34															7,900,000	20,000	49,000,000
11	13	12 25P	35															7,900,000	130,000	43,000,000
11	14	07 00A	33															3,300,000	50,000	20,000,000
11	15	11 50A	32															7,900,000	110,000	18,000,000
11	16	04 20P	36															17,200,000	330,000	12,000,000
11	17	04 25P	32															13,000,000	80,000	17,000,000
11	18	07 10A	36															17,200,000	20,000	20,000,000
11	19	07 30A	34															17,200,000	20,000	19,000,000
11	20	01 10A	32															13,000,000	20,000	42,000,000
AV			34		278.5	3108.2	331.	7.6	0	223		309			794	48	975	11,601,429	192,857	40,121,429

* Indicates less than

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NORTH PLATTE RIVER SURVEY
WYOMING - NEBRASKA
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RESULTS OF ANALYSES
STATION 19 (RM208.8)

Month	Date	Sample Time	Temp. °C	D.O. mg/l	B.O.D. mg/l	Susp. Solids mg/l	Volatile Susp. Solids mg/l	pH	Alkal. Phenol mg/l (as $CaCO_3$)	Alkal. Total mg/l (as $CaCO_3$)	Cl^- mg/l	Hard. mg/l	Ca. mg/l	Mg. mg/l	Spect. Conduct µmhos/cm.	True Color Units	Turb. Units	Coli. M.P.N. Per 100 ml.	Fecal Coli M.P.N. Per 100 ml	Fecal Strep Per 100 ml.
11	07	07 45A	42															7,900,000	170,000	90,000,000
11	08	10 57A	38															4,900,000	170,000	28,000,000
11	09	07 00A	41															7,900,000	50,000	102,000,000
11	10	10 25A	38															3,300,000	80,000	90,000,000
11	11	06 30A	38															4,900,000	*20,000	114,000,000
11	12	09 55A	46		1170.	1488.	320.	7.2		235		394			892	100	900	*20,000	*20,000	100,000
11	13	07 05A	34		1360.	441.	98.	9.6	48.2	268		453			980	190	900	10,900,000	20,000	19,000,000
11	14	10 15A	40		1030.	1820.	332.	6.9	0	226		476			901	100	1100	7,900,000	50,000	39,000,000
11	15	07 15A	36		1880.	1920.	552.	11.5	279.	559		710				360	1200	3,300,000	*20,000	171,000,000
11	16	03 40P	38															6,300,000	230,000	110,000,000
11	17	22 55P	38															3,300,000	20,000	93,000,000
11	18	09 25A	35															13,000,000	20,000	19,000,000
11	19	03 25A	34															4,900,000	*20,000	510,000,000
11	20	05 00A	35															13,000,000	80,000	340,000,000
AV			38		1360.	1417.2	325.5	8.8	81.8	322		508			924	187	1025	7,038,615	89,000	132,692,308

* Indicates less than

63

NORTH PLATTE RIVER SURVEY
WYOMING - NEBRASKA
SEPTEMBER & NOVEMBER 1961
RESULTS OF ANALYSES

STATION 20 (GH084-1.5)

Month	Date	Sample Time	Temp. °C	D.O. mg/l	B.O.D. mg/l	Susp. Solids mg/l	Volatile Susp. Solids mg/l	pH	Alkal. Phenol mg/l (as $CaCO_3$)	Alkal. Total mg/l (as $CaCO_3$)	Cl^- mg/l	Hard. mg/l	Ca. mg/l	Mg. mg/l	Specf. Conduct µmhos/cm.	True Color Units	Turb. Units	Coli. M.P.N. Per 100 ml.	Fecal Coli M.P.N. Per 100 ml.	Fecal Strep. Per 100 ml.
11	07	09 10A	28															13,000,000	300,000	8,400,000
11	08	09 20A	24															17,200,000	490,000	6,300,000
11	09	08 30A	26															22,100,000	200,000	2,600,000
11	10	08 00A	31															10,900,000	*200,000	4,500,000
11	11	08 10A	24															7,900,000	400,000	6,100,000
11	12	08 35A	30		624.	4612.	752.	9.3	37.8	189		323			636	50	1600	13,000,000	200,000	1,400,000
11	13	08 45A	26		670.	5108.	872.	9.2	32.2	188		312			666	70	1800	542,000,000	7,900,000	16,200,000
11	14	08 30A	29		607.	5276.	824.	9.2	35.8	196		332			662	85	1800	7,000,000	*200,000	9,800,000
11	15	08 45A	29		764.	5636.	1056.	9.2	36.0	190		320				50	1800	2,200,000	*200,000	2,700,000
11	16	01 35P	24															10,900,000	*200,000	2,600,000
11	17	02 25P	26															13,000,000	*200,000	11,400,000
11	18	07 50A	24															24,000,000	*200,000	1,500,000
11	19	04 40A	28															4,600,000	*200,000	17,000,000
11	20	03 35A	27															13,000,000	*200,000	26,000,000
AV			26		666.25	5158.	876.	9.2	35.4	190		321			658	63	1750	50,057,143	1,548,333	8,321,429

* Indicates less than

54

NORTH PLATTE RIVER SURVEY
WYOMING - NEBRASKA
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RESULTS OF ANALYSES
STATION 21 (GS173.8-3.0)

Month	Date	Sample Time	Temp. °C	D.O. mg/l	B.O.D. mg/l	Susp. Solids mg/l	Volatile Susp. Solids mg/l	pH	Alkal. Phenol mg/l (as $CaCO_3$)	Alkal. Total mg/l (as $CaCO_3$)	Cl − mg/l	Hard. mg/l	Ca. mg/l	Mg. mg/l	Spect. Conduct. µmhos/cm.	True Color Units	Turb. Units	Coli. M.P.N. Per 100 ml.	Fecal Coli M.P.N Per 100 ml.	Fecal Strep. Per 100 ml.
11	07	03 50P	38																	
11	08	11 00A	30		1320.	5790.	872.	11.6	262.	513		772			1785	90	2000	7,900,000	490,000	6,200,000
11	09	11 40A	38		1250.	5516.	720.	9.1	62.0	258		446			953	220	1700	2,400,000	50,000	570,000
11	10	07 20A	36		1310.	5656.	1400.	11.3	222.	539		731			1610	270	1900	3,300,000	200,000	8,800,000
11	11	12 00A	33		1700.	6568.	800.	10.0	73.8	358		589			1390	190	2000	2,400,000	230,000	4,500,000
11	12	07 10A	35															4,900,000	110,000	6,100,000
11	13	12 40P	37															2,210,000	*20,000	14,000,000
11	14	06 40A	35															*20,000	*20,000	16,200,000
11	15	12 05P	37															*20,000	*20,000	9,800,000
11	16	04 35P	34															3,300,000	330,000	80,000,000
11	17	04 35P	34															2,400,000	40,000	24,000,000
11	18	06 45A	32															2,780,000	50,000	14,000,000
11	19	07 40A	30															790,000	20,000	86,000,000
11	20	12 55A	34															4,900,000	50,000	10,200,000
AV			34		1395.	5882.5	948.	10.5	154.9	417		634			1435	192	1900	2,400,000	200,000	3,000,000
																		3,306,666	159,091	20,240,714

* Indicates less than

55

NORTH PLATTE RIVER SURVEY
WYOMING - NEBRASKA
SEPTEMBER & NOVEMBER 1961
RESULTS OF ANALYSES

STATION 22 (CB150-2.5)

Month	Date	Sample Time	Temp. °C	D.O. mg/l	B.O.D. mg/l	Susp. Solids mg/l	Volatile Susp. Solids mg/l	pH	Alkal. Phenol mg/l (as $CaCO_3$)	Alkal. Total mg/l (as $CaCO_3$)	Cl⁻ mg/l	Hard. mg/l	Ca. mg/l	Mg. mg/l	Specf. Conduct. µmhos/cm.	True Color Units	Turb. Units	Coli. M.P.N. Per 100 ml.	Fecal Coli M.P.N Per 100 ml.	Fecal Strep. Per 100 ml.
11	07	12 30P	32															230,000	*20,000	7,500,000
11	08	07 15A	31															16,000,000	63,000	11,000,000
11	09	09 45A	31															16,000,000	141,000	12,600,000
11	10	09 20A	32															3,300,000	70,000	67,000,000
11	11	11 00A	34															3,300,000	400,000	19,000,000
11	12	09 10A	30															790,000	80,000	13,000,000
11	13	10 40A	31															3,300,000	*20,000	9,800,000
11	14	08 25A	30															10,900,000	20,000	8,000,000
11	15	10 15A	29															7,900,000	20,000	16,000,000
11	16	02 15P	32		550.	4952.	792.	8.9	20.6	204		340			770	55	1200	4,900,000	*20,000	11,000,000
11	17	01 05P	32		576.	6392.	976.	9.0	23.4	210		355			769	55	2300	10,900,000	*20,000	11,200,000
11	18	09 05A	29		606.	5796.	944.	8.9	21.2	198		324			775	48	1700	24,000,000	20,000	20,000,000
11	19	06 10A	24		600.	7512.	880.	8.9	18.2	224		355			800	50	2300	4,600,000	20,000	6,300,000
11	20	02 10A	26															7,900,000	*20,000	9,600,000
AV			30		583.0	6163.	898.	8.9	20.8	209		340			779	52	1879	8,144,286	70,444	16,000,000

* Indicates less than

NORTH PLATTE RIVER SURVEY
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RESULTS OF ANALYSES

STATION 23 (QB150-2.0)

Month	Date	Sample Time	Temp. °C	D.O. mg/l	B.O.D. mg/l	Susp. Solids mg/l	Volatile Susp. Solids mg/l	pH	Alkal. Phenol mg/l (as CaCO3)	Alkal. Total mg/l (as CaCO3)	Cl⁻ mg/l	Hard. mg/l	Ca. mg/l	Mg. mg/l	Spect. Conduct. µmhos/cm.	True Color Units	Turb. Units	Coli. M.P.N. Per 100 ml.	Fecal Coli M.P.N. Per 100 ml.	Fecal Strep. Per 100 ml.
11	07	12 20P	6															490,000	*20,000	490,000
11	08	07 05A	1															2,400,000	20,000	640,000
11	09	09 55A	4															2,210,000	20,000	360,000
11	10	09 10A	3															4,900,000	*20,000	1,800,000
11	11	10 55A	8															490,000	*20,000	530,000
11	12	09 00A	4															1,720,000	*20,000	1,400,000
11	13	10 30A	4															2,400,000	20,000	630,000
11	14	08 15A	1															2,210,000	20,000	1,300,000
11	15	10 25A	2															270,000	*20,000	870,000
11	16	02 05P	1		174.	56.	44.	7.6	0	388	480				1052	50	90	790,000	*20,000	2,300,000
11	17	12 55P	2		176.	77.	57.	7.7	0	340	442				953	65	100	3,300,000	*20,000	1,100,000
11	18	08 55A	1		231.	56.	23.	7.7	0	342	444				951	55	60	3,300,000	*20,000	1,800,000
11	19	06 20A	0		236.	384.	73.	7.8	0	372	490				1041	50	240	790,000	*20,000	2,300,000
11	20	02 20A	0															1,720,000	*20,000	4,700,000
AV			2		204.25	143.2	49.2	7.7	0	355	464				999	55	122	1,927,857	20,000	1,444,286

* Indicates less than

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STATION 24 (MO173-1.5)

Month	Date	Sample Time	Temp. °C	D.O. mg/l	B.O.D. mg/l	Susp. Solids mg/l	Volatile Susp. Solids mg/l	pH	Alkal. Phenol mg/l (as $CaCO_3$)	Alkal. Total mg/l (as $CaCO_3$)	Cl − mg/l	Hard. mg/l	Ca. mg/l	Mg. mg/l	Specf. Conduct. µmhos/cm.	True Color Units	Turb. Units	Coli. M.P.N. Per 100 ml.	Fecal Coli M.P.N Per 100 ml.	Fecal Strep. Per 100 ml.
11	15																	7,900,000	3,300,000	25,000,000
11	16	04 15P																4,900,000	1,090,000	2,300,000
11	17	04 15P																92,000,000	17,200,000	36,000,000
11	18	07 05A																4,900,000	4,900,000	1,500,000
11	19	07 25A																3,300,000	1,300,000	500,000
11	20	01 08A																4,900,000	3,300,000	98,000,000
																		19,650,000	5,181,667	27,216,657

8.5

APPENDIX B

DEOXYGENATION

DEOXYGENATION

DEOXYGENATION RATE

k_1 — The rate coefficient of the demand for oxygen as the result of the biochemical oxidation of organic matter. Here the rate of the demand is important. The rate of deoxygenation is the rate at which the oxygen demands of the biochemical oxidation process are satisfied or exerted. The rate is proportional to the remaining concentration of unoxidized substance measured in terms of oxidizability.

k_1 Formulation

Using common logs - base 10:

(1) $$k_1 = \frac{\log La - \log L_t}{t}$$

La = BOD at upstream station.
Lt = BOD at time "t".
t = Time of travel in days.

(2) Also: log % BOD remaining = $2 - k_1 t$.

Using the Torrington and Mitchell Stations:

$$k_1 = 0.42 \text{ per day.}$$

The k_1 value of 0.42 is high. In many cases the k_1 value is assumed to be 0.1.

Assuming a time of 1 day, and a k_1 value of 0.42,

log % BOD remaining = 2-k_1 t.

log % BOD remaining = 2-0.42 x 1.

% BOD remaining = 38.

At a k_1 rate of 0.42, at the end of 1 day 62% of the BOD will be satisfied. At the end of the second day 14.5% of the original BOD will remain or 85.5% will be satisfied.

At a k_1 rate of 0.1, 79.5% of the original BOD will remain at the end of the first day.

At, and below, the Bayard station the deoxygenation rate or k_1 was found to be 0.26 per day.

APPENDIX C

BACTERIOLOGICAL EXAMINATION OF STREAM SAMPLES

BACTERIOLOGICAL EXAMINATION OF STREAM SAMPLES

INTRODUCTION TO METHODOLOGY

The standard tests for the coliform group described in Standard Methods for the Examination of Water and Wastewater, 11th edition, 1960 (1) are designed specifically for the quantitative determination of the coliform group. The coliform group includes all the aerobic and facultative anaerobic, non-spore-producing, gram-negative rods which ferment lactose with gas production within 48 hours at 35 ($\pm$ 0.5)° C. The standard tests are:

1. Presumptive Test (based on gas production from lactose) in which a negative reaction excludes the coliform group and a positive test indicates that coliform bacteria may be present.
2. Confirmed Test which demonstrates gas production from lactose in the presence of bile salts and brilliant green.

The above Standard Methods procedures, by not distinguishing between the various types of coliform bacteria composing the coliform group, yield no information as to their possible source or origin. A group of tentative differential tests is described but no suggestions are given as to their interpretation other than such procedures seldom

give sufficient information to justify the labor and time required for the procedures. Presence or absence of the coliform group is all that is necessary in the bacterial examination of a potable water and the standard tests are adequate for this purpose (2).

The objectives in the bacteriological investigation of untreated surface waters, such as used in a stream survey, must go beyond the procedures described in Standard Methods. Bacteriological objectives include the quantitative estimation of all indicator microorganisms of pollution so that as much information as to the probable sources and significance can be collected as is consistent with accepted bacteriological research methods and practices.

In the accomplishment of these objectives, it is necessary to use newer research methods which are beyond the scope and objectives of the procedures in Standard Methods. The testing methods include the elevated temperature test which indicates the fecal or non-fecal origin of coliform bacteria and the streptococcal method as an indicator of pollution. Both of the procedures and their interpretation have been established by detailed research investigations on the distribution of indicator microorganisms in feces as well as in other environments (3,4,5,6,7,8).

METHODS OF EXAMINATION

Bacteriological procedures used in the examination of stream samples are shown in Chart 8 following Page 17. Procedures which are marked with an asterisk are described in Standard Methods while unmarked methods represent tests not described and are the product of recent research studies.

DISCUSSION OF TESTS

Stream samples are collected and examined for the coliform group according to the procedures described in Standard Methods. These procedures include the use of lauryl tryptose broth for a screening test and confirmation of the presumptive positive tubes in brilliant green bile lactose broth. This is considered preferable to the lactose broth option in the presumptive test. The "Confirmed Test" enumerates the coliform group in the sample but yields no information as to probable source, such as being derived from feces, soil, plants etc.

Elevated Temperature Test (EC) at 45° C.

The procedure for the Elevated Temperature Test consists of the following steps:

1. Transfer a loop of broth from the positive presumptive tube to an EC broth tube containing an inverted vial to indicate gas production.
2. Place the inoculated EC tube, within less than 30 minutes after planting, in a water bath at 44.5 - 45.0°C.
3. Incubate at 44.5 - 45.0° C. for 24 ($\pm$ 2) hours in water bath.
4. Record the presence or absence of gas in the inverted vial.

The presence of gas in the inverted vial is a positive reaction indicating that coliforms derived from the gut of warm-blooded animals (fecal coliforms) were present in the sample. Absence of gas indicates the absence of fecal coliforms in the tube since the members of the coliform group derived from non-fecal sources generally fail to produce gas in this medium at 44.5 - 45.0° C. The fecal coliform density is calculated on the number of positive and negative tubes in the series in the same manner as for the coliform group MPN.

Streptococcal Colony Count

Streptococcal enumerations are made by the membrane filter technique using KF Streptococcus Agar as nutrient substrates. The medium is prepared as follows:

1. Mix 7.64 grams of KF Streptococcus Agar (Difco 0496) with 100 ml sterile distilled water in a sterile flask.

2. Place the flask containing the mixture in a boiling water bath to dissolve the medium containing the agar.

3. After solution is complete, continue heating in the boiling water bath for five (5) minutes.

4. Cool medium to between 50 - 60° C.

5. Add one (1) ml of sterile aqueous solution of one (1) per cent TTC (triphenyl-tetrazolium chloride)* solution and mix.

6. Pour from 5 - 8 ml of melted medium in each sterile plastic petri dish (Falcon No. PD5012) and replace lid until medium hardens.

The medium is ready for immediate use or may be used at any time within 30 days, provided it is stored in a dark place and no evaporation has occurred during storage.

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* 2,3,5-triphenyl-tetrazolium chloride No. 6533, Eastman Organic Chemicals, is recommended. Do not autoclave solutions of this compound.

The procedure for the test consists of:

1. Filter an appropriate quantity of sample through the membrane filter.

2. Place filter on KF Streptococcus Agar, grid side up, using care to have no air bubbles between the membrane filter and agar surface.

3. Incubate at 35° C. for 48 hours (up to 72 hours is permissible).

4. Count all red or pink colonies, using a magnification of 10 - 20 diameters.

5. Calculate count per unit volume as streptococcal colony count per unit (usually 100 ml or 1 ml) volume.

The group of streptococci which meet the above definition are always found in feces and has little or no ability to produce after-growth in the stream. They are present in greater numbers than the coliform group in the feces of most domestic animals, while the coliform group outnumber the streptococci in human excreta.

Fecal streptococci, like the fecal coliform group, is interpreted to indicate fecal pollution. As the numbers of the indicators increase, the quantity of fecal pollution increases. However, each should be considered as an independent indicator of pollution. Survival rates of each group vary under any specific environment and may vary greatly from environment to environment. Conditions may exist where one or the other indicator may die at a greatly accelerated rate.

REFERENCES

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2. Kabler, P. W. and Clark, H. F. "Coliform Group and Fecal Coliform Organisms as Indicators of Pollution in Drinking Water." Jour. Amer. W.W. Assoc., 52: 1577 (1960).

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APPENDIX D

REDUCTION OF POTENTIAL POLLUTION BY BEET SUGAR PLANTS - WASTES DISCHARGED DURING NOVEMBER 1961 STUDY

REDUCTION OF POTENTIAL POLLUTION BY BEET SUGAR PLANTS - WASTES DISCHARGED DURING NOVEMBER 1961 STUDY

At the Torrington, Wyoming, Holly Sugar Company plant (19) (HT-208.8), a number of changes have occurred since 1950. Among these changes have been the following that have reduced the potential waste load to the river:

1. Ponds have been provided to receive the lime and Steffen wastes.
   Ponding of the lime waste was started in 1954.
   Ponding of Steffen waste started in 1956, and several additions have been made since that time.

2. Installation of a traveling screen in 1956. This screen is in the main sewer as it leaves the factory building. It is estimated that this screen removes 60 tons of material per day from the main sewer.

3. In 1955 a shaker screen was installed to rescreen the pulp silo waste. Additions were made to this unit in 1960. It is estimated that this screen removes 60 tons of pulp per day from the pulp silo waste that originally discharged to the river.

4. In 1960 a septic tank was installed to handle the plant's sanitary wastes prior to discharge to the plant sewer.

5. In 1961 a fine screen was installed in the main sewer between the factory and the plant outfall to the river.

The principal wastes discharged from the Torrington plant

during November included:

1. Flume Water.
2. Pulp Screen Water.
3. Pulp Press Water.
4. Pulp Silo Drainage.

The Great Western Sugar Plant located at Mitchell, Nebraska (20) (GM-184-1.5) is the first sugar plant on the North Platte as the river flows from Wyoming into Nebraska. This plant is a non-Steffen operation. Measures beneficial to pollution control at this plant include:

1. Use of a Pulp Dryer.
2. Reuse of Pulp Screen and Pulp Press Water as Process Water.
3. Removal by settling, of the heavier material from the Flume Water.

The principal wastes from this plant include:

1. Flume Water.
2. Lime Wastes.

The next Great Western Plant downstream is the Gering (16) (GG-173-1.5) plant. This plant includes a Steffen house. Measures taken that have reduced pollution include:

1. Use of a Pulp Dryer.
2. Lime Wastes discharged to a pond, with no discharge to the river.
3. Removal of Steffen waste from the sewer. (This waste is concentrated and sent elsewhere for additional processing).
4. Reuse of the Pulp Screen and Pulp Press Water as Process Water.

The principal waste discharged from this plant is flume water.

The next Great Western plant is the one at Scottsbluff (21) (GS-173.8-3.0). This plant is the largest of the Great Western plants in this reach of the North Platte River. It includes a Steffen house. Wastes have been reduced by:

1. Eliminating the Steffen waste from the plant wastes. The Steffen waste is pumped from this plant to the Gering plant where it is evaporated and sent elsewhere for additional processing.

2. Pulp screen water is returned as Process Water.

Wastes from the Scottsbluff plant include:

1. Flume Water.

2. Pulp Silo Drainage.

3. Lime Waste.

The Great Western plant at Bayard is the last plant downstream in the Torrington to Broadwater reach of the river. The plant is a non-Steffen operation. In-plant waste reduction has been accomplished by the use of pulp dryers. Principal waste discharges from the plant include:

1. Flume Water.

2. Lime Wastes.

Treatment facilities are provided for the wastes discharged from this plant by a broad-field irrigation system (or grass field aeration system). The plant waste discharges to a ditch that transports the waste to a pump house. A coarse, manually-cleaned, bar screen is provided across the ditch as the waste discharges to the pump house well. An overflow pipe is provided in the waste ditch, just ahead

of the screen, to prevent flooding when the screen clogs. The overflow pipe permits the discharge of some untreated wastes directly to an adjacent canal. The waste entering the pump house well is pumped across the canal to the broad-field distribution system. The waste discharged to the field flows across the field where aeration and settling occur. A collection ditch across the lower end of the field collects the treated waste and discharges it to the canal.

The material included here on treatment facilities and process changes may not include all changes beneficial to pollution control, but includes those with the greatest significance.